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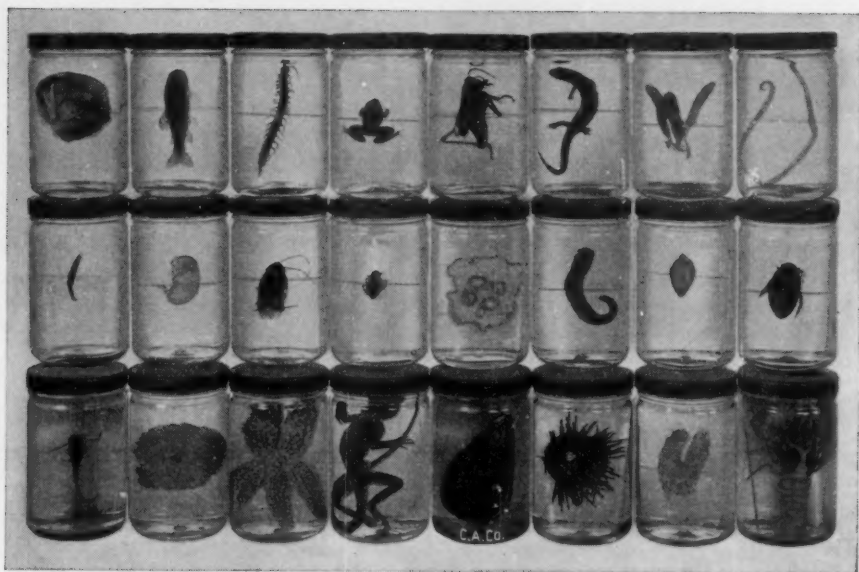
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Science Education

WHAT IS THE SCIENTIFIC ATTITUDE?

ROBERT L. EBEL

Roosevelt High School, Cedar Rapids, Iowa

There are two reasons why a sound definition of the scientific attitude should be a part of the progressive science teacher's equipment. In the first place, modern educational thought regards the imparting of the scientific attitude as a fundamental obligation of science teaching. This conviction is clearly revealed in statements of objectives for science teaching and in the reports of individuals and committees concerned with science education. In the second place, one prerequisite to effective teaching of the scientific attitude is a concise definition of it. For we can neither teach effectively nor measure the results of our teaching without a definite notion of what is to be taught.

The problem of providing a sound definition of the scientific attitude has already received considerable attention at the hands of philosophers, scientists and educational research workers. Aristotle, Bacon, Huxley, Darwin, Dewey and Russell are among the many who have attempted to analyze subjectively the attitudes of mind that contribute to scientific achievement. It is the rather popular scientific fashion to regard with contempt the products of such subjective thinking. Yet in this case that contempt is misplaced, for as Noll¹⁸ has pointed out, "Obviously the definition (of the scientific attitude) must depend on subjective analysis because attitudes cannot be observed directly but only through their manifestations in behavior." We may observe the behavior directly, but we can only speculate on the mental condition which produced it. Thus, whether we like it or not, our

definition of the scientific attitude must be based on inferences from observed behavior.

But it is not necessarily true that this subjectivity dooms any attempt at definition to incorrectness. The inferences need only be the starting point of our definition. If they are examined critically, subjected to such tests as can be devised, and combined judiciously, their inaccuracies may be exposed and eliminated. It is likewise not necessarily true that any one of these philosophical definitions is complete and satisfactory in itself. And certainly they cannot each be complete and satisfactory, for in most cases they differ considerably from each other. Being the products of individual opinion and hence being conditioned largely by the past experiences of the individual, they vary widely in content and emphasis. It is altogether possible that no one of them is complete. It is probable that some of them contain incorrect elements. Therefore, while we must build our definition of the scientific attitude on the basis of these subjective judgments, it is apparent that we cannot use those judgments directly. Some technique for checking and compiling them must be employed.

Two recent efforts to define the scientific attitude^{4,5} illustrate one approach to this problem of checking and compiling the subjective judgments. The philosophy underlying the procedure in both cases apparently was something like this.

The scientific attitude consists of a relatively small number of essential elements. But the philosophical definitions of the attitude have suggested a great many elements. Some of these suggestions

are probably wrong. Certainly not all of them are worthy of equal stress. Therefore, the job of the objective definer of the scientific attitude is to submit these multitudinous philosophic suggestions to competent judges, who will decide which, being most important, should be included in the final definition.

In both cases the same general procedure was followed. The investigator reviewed the philosophical definitions and prepared a tentative list of elements which in his opinion might be elements of the scientific attitude. He submitted this list to a number of selected judges, who evaluated the various suggestions and proposed additions, eliminations, and changes in the wording, emphasis or arrangement. The investigator then revised his list on the basis of the various judgments.

A comparison of the definitions produced by this method in the hands of the two investigators reveals a striking lack of agreement. While harmony between the two definitions would not be the only or even the best indicator of correctness, since consistent use of faulty technique could produce consistent though faulty results, it is true that the absence of substantial agreement does suggest a lack of soundness. Therefore, we are led to examine the procedure critically in the hope of discovering its faults.

We observe, in the first place, that the two investigators did not start with the same preliminary list of attitudes. There are very definite reasons why each investigator had to edit the philosophic suggestions concerning scientific attitudes before passing them on to the judges. To have included all the suggestions that occur in the literature would have given an unreasonably long questionnaire. To have quoted the suggestions exactly would have given a confusing questionnaire, since the suggestions occur in varying contexts and under various forms of statement. But apparently it was felt that this preliminary editing was of minor importance when compared with the essential process of securing expert judgments, for no rigorous, definite editorial policy was

followed. As a consequence, the preliminary lists were decidedly different and, what is more important, that difference was not appreciably reduced by the modification which the judges suggested. It is thus evident that the subjective preliminary editing, which was almost entirely uncontrolled in the procedure used, was really of great significance in determining the nature of the final definition. The introduction of this important but uncontrolled factor in the process of definition constitutes the first defect in technique.

In the second place, we notice that the questionnaire technique was employed to secure judgments which call for much reflective thinking. While there is apparently no specific objective evidence on the reliability of the questionnaire as a device for selecting elements of the scientific attitude, there is reason for general distrust of the questionnaire as a means of securing judgments. In an analysis of seventy-seven questionnaire studies involving expression of opinion, Koos¹⁵ found that fifty-two were questionable on the ground that the persons responding lacked ability to give truly accurate answers.

Furthermore, there are several reasons why less careful answers are given to questions requiring the exercise of judgment. Reflective thinking is hard work and takes time. The experts to whom the questionnaires are addressed, being busy with their own endeavors and not directly interested in the matter being probed by the questionnaire, will tend to answer in a haste which precludes the exercise of the necessary reflective thinking. The questioner has no right to expect, and apparently does not often get thoroughly thought out answers to questions that require judgment. For these reasons, the use of the questionnaire in developing the definition constitutes a second defect of technique.

The third weakness is that the procedure secures composite judgments in relation to a matter that really demands advanced

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thinking. Is there any reason to believe that the composite judgment of a group of experts concerning scientific attitudes is necessarily closer to the truth than the judgment of any single member of the group? In Galileo's day, would the composite judgment of the professors concerning falling bodies have come closer to the truth than the judgment of one young professor in the group? New ideas are not developed by composite judgments; they arise from independent, individual investigation. The definition of the scientific attitude is a problem which requires the development of new ideas. Composite judgments may be interesting information, and useful in certain connections, but they should not be set up as ideals or standards. They represent the status quo, not the ultimate desideratum.

Finally, we notice that the definitions rest upon supposedly expert judgment, although there is, as yet, little expertness with reference to the scientific attitude. Expertness in any field is a specific thing, and no matter how well trained or successful a scientist or science teacher may be, he does not qualify as an expert in judging the elements of the scientific attitude unless he has specifically and thoroughly studied the nature of the scientific attitude for himself. There is little evidence in the literature that this specific and thorough study has been sufficiently wide-spread to create any significant body of experts. Furthermore, the exercise of expert judgment presupposes the existence of some commonly accepted standard or criterion as a basis for the judgment. But in this case no such standard was set up by the investigators, and it is unlikely that any substantial proportion of the judges took time to develop consistent standards of their own. It is in this absence of expertness and of standards for judgment that we find the fourth defect in technique.

In our discussion of the procedures used by these investigators we have considered only the defects. The fact that there were four of them by no means proves that the

definitions are valueless. On the contrary, they are among the best yet produced. But since the defects are serious and, with the possible exception of the first, are inherent in the technique itself, it is evident that any real improvement in the definition of the scientific attitude will require a different approach to the problem.

As a first step in attempting a new attack on the problem of defining the scientific attitude, we formulated the following basic philosophy.

The scientific attitude is a unified state of mind. Philosophical speculations have suggested a great many characteristics of the attitude. Any sound definition of the scientific attitude must be based upon these suggestions. But some of the suggestions may be wrong. And in their present form they are confused, disjointed and overlapping. Therefore the job of the logical definer of the scientific attitude is (1) to search the literature for as many philosophical suggestions of the scientific attitude as possible, (2) to set up certain definite criteria for judging which are and which are not true characteristics of the scientific attitude, (3) to test these suggestions in terms of the criteria established and retain only those which pass the test, (4) to classify the characteristics accepted in terms of their common elements, (5) to determine the relations existing between the various classes and members of classes, and (6) to formulate finally an integrated statement of the scientific attitude which truly corresponds to the unified state of mind.

Perhaps the whole idea of this philosophy can be made clearer by the use of an analogy. Suppose that you discover a box containing a number of irregularly shaped pieces of cardboard. You recognize that some of the pieces are elements of a jig-saw puzzle, and immediately set to work to reconstruct the puzzle picture. Your first move, probably, would be to separate the jig-saw pieces from the scraps of cardboard, making use of certain criteria, such as the shape of the piece and the coloration of the faces. Your next move would be to sort out the various pieces on the basis of their color, design, border, etc. Then you would begin to fit together the individual pieces in each group, and to relate each group to the others. The gradually appearing design would facilitate the work and would enable

you to detect the absence of any piece and to determine its general character. In the end, a complete picture would be obtained, and you would be satisfied that you had solved the puzzle, not because someone approved your work, but because of its apparent internal consistency and completeness.

The process of constructing a sound, integrated definition of the scientific attitude is similar, but very much more difficult. The various suggestions constitute the pieces of our puzzle (although philosophic suggestions are considerably less definite than pieces of cardboard). The first task is to sort out the true elements of the scientific attitude from the false, using a definite standard or criterion. The next is to classify the various elements and to fit them together. In this process, certain characteristics of the attitude will gradually become apparent and will aid in the placement of other elements. Finally a complete, integrated definition will emerge.

Acting in accord with this philosophy, we set about to develop a satisfactory definition of the scientific attitude. The following requirements for the finished product were set up to define the problem and guide our work.

- I. The statement must be complete, being based on the widest possible survey of suggestions concerning characteristics of the scientific attitude.
- II. The statement must be accurate.
 - A. All of its elements must fit a rigorous definition of the term "attitude."
 - B. All of its elements must fit a rigorous definition of the term "scientific" as it is used in relation to attitudes.
 - C. All of its elements must be stated in concise, meaningful terms.
- III. The statement must be integrated.
 - A. All of its elements must be grouped on the basis of their common characteristics.
 - B. All of its elements must be arranged to show the relationships existing between them.

On the basis of these requirements, the first problem was that of surveying the literature in order to gather as many sugges-

tions concerning the scientific attitude as possible. The references which provided these suggestions are marked with an asterisk in the list at the end of the article. A total of 432 separate suggestions were gathered. Not all of the suggestions were definitely labeled as elements of the scientific attitude in the context. If a statement seemed to relate in any way to the scientific attitude, it was "booked for investigation."

Furthermore, not all of the suggestions came from recognized authorities, for in the process of collecting, classifying and arranging these suggestions, certain other ideas occurred to the investigator and were listed along with the rest. Such additions could be justified on the ground that it was not authority of source, but compliance with definitions of "attitude" and "scientific" which was to determine whether or not a suggestion should be accepted. To aid in a later process of classification and arrangement, each suggestion was given a label which identified its source and expressed its central idea, and was then typed on a separate slip of paper.

With the suggestions collected, the next problem was to obtain a rigorous definition of "attitude." The definitions given in six standard dictionaries,⁷ one encyclopaedia,¹⁰ and in one other reference¹⁴ were collected and carefully studied. It soon became apparent that the term "attitude" has at least three different meanings, which are not always distinctly separated in the definitions given. There are physical attitudes, expressive attitudes, and mental attitudes. It is clearly this third meaning which relates to the scientific attitude.

But even with this distinction established, there remains an apparently irreconcilable difference between the various definitions which relate specifically to the mental attitude. If a mental attitude is a "position or disposition with regard to a person or thing," then it is obviously a mental condition. If, on the other hand, a mental attitude is a "habitual mode of regarding any-

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thing," then it is clearly a type of mental activity. The original use of the term in applying to physical position (or condition) lends weight to the first interpretation. Furthermore, the most authoritative definition of a mental attitude on the list, since it was proposed by the American Psychological Association, supports the mental condition concept by defining an attitude as "a stabilized set or disposition." If an attitude is a mental condition, it is not difficult to account for the confusion which has caused it to be regarded as a mental activity. For a mental condition cannot be observed directly, but only through its influence on behavior. Thus the behavior has been confused with the mental condition which produced it. For all these reasons we are led to favor the mental condition concept.

On the basis of these distinctions and interpretations, the suggestions of the various definitions were combined into this final statement which was adopted as our guide:

An attitude is a stabilized mental set which expresses itself in a tendency to react to any member of a class of stimuli in the same general way.

The term "stabilized" expresses the relative permanence of attitudes. Attitudes are, in a sense, habitual, but it is hardly accurate to define them as "habits of thinking." For habits of thinking might include such things as "Two plus two equals four," and "Where there is smoke, there is fire," which are certainly not attitudes.

The subordinate clause in the definition is simply an explanation of the meaning of "mental set," in terms of the effect it produces. Such an explanation is necessary, because in using the definition to pick out mental sets, the sole basis of judgment is the effects which the sets produce. The latter part of the definition also expresses the generalized nature of attitudes in the term, "class of stimuli." If, for example, a person has an attitude of fear toward snakes, that attitude functions whether the stimulus is a large snake or a small one, a live snake or a dead one, a poisonous snake

or a harmless one. In fact, the stimulus need not even be a snake at all, for an artificial imitation, or even a suspiciously sinuous stick of wood, will evoke the same type of response.

The next problem was to formulate a rigorous definition of the term "scientific" as it is used in relation to attitudes. Scientific attitudes might be interpreted either as the attitudes which have existed in the minds of outstanding men of science, or as the attitudes which tend to foster scientific achievement. The two interpretations overlap, but are not identical. Outstanding scientists have frequently displayed such attitudes as those of appreciation and reverence, which are common characteristics of well-developed personalities, but which do not tend to foster scientific achievement. It is obvious that the second interpretation will give us a list of attitudes that is more thoroughly scientific and more useful. On the basis of these considerations, the following definition of a scientific attitude was formulated.

A scientific attitude is an attitude which will tend to foster scientific achievement.

The term "scientific achievement" is here used in a broad sense and includes: (1) any addition to the world's store of organized truth, (2) any addition to the individual's store of organized truth, or (3) any use of organized truth as a basis for determining action.

A word should be said here about the distinction between the scientific attitude and the scientific method. The two terms have apparently been much confused in the past, although they really involve quite separate concepts. An attitude is a mental condition, while a method is an organized series of acts. The scientific attitude is indeed closely related to the scientific method, for the attitude gives rise to the method, and the method gives evidence of the attitude. It is this close relationship which has led to the confusion.

(To be concluded in February issue)

BIOLOGY OBJECTIVES VALUABLE FOR SOCIAL UNDERSTANDING*

ARCH D. LANG

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PROBLEM

It is widely held that present social maladjustments are partly due to the fact that progress in the physical sciences has outstripped progress in the life sciences and especially in the social sciences. From this point of view, control of social forces depends on understanding and control of life processes and human nature.

Whether biology does contribute toward social understanding apparently has not been objectively determined. Numerous objectives of biology teaching have been set up by opinion. From them we have a clearer view of the values to be derived from biology than was possible twenty years ago. But biology teaching suffers from the lack of scientific determinations of objectives comparable to those which are recognized in subjects such as spelling, reading, and arithmetic.

The purpose of this study is to validate objectives of biology teaching on the basis of their use in dealing with social problems treated in high school sociology textbooks. Presumably biology is used in these books when it helps to explain social problems. By analyzing these books for biological references definite knowledge is sought as to whether biology is useful for social understanding, and what biology is most useful.

METHOD

Six books were analyzed. Sociology was chosen as most nearly representing the whole field of social studies on the high school level. The books used as sources were selected from the *Cumulative Book Index* (New York: The H. W. Wilson Co., 1933, 1935, 1936), and as far as could be

* Abstract from *Biological Concepts and Principles Basic to Sociology*. Master's thesis, Miami University, Oxford, Ohio, 1936.

determined included all the high school sociology textbooks published as original or revised editions during the years 1930-35. The sources were as follows:

1. Elliott, M. A., and others. *Our Dynamic Society*. New York: Harper and Brothers, 1935. 380 plus viii pp.
2. Ellwood, C. A. *Social Problems and Sociology*. New York: American Book Co., 1935. 436 pp.
3. Finney, R. L., and Mills, M. C. *Elementary Sociology*, third edition. Chicago: Sandborn and Co., 1935. 340 plus ix pp.
4. Gavian, R. M., and others. *Our Changing Social Order*. Boston: D. C. Heath and Co., 1934. 577 plus xi pp.
5. Ross, E. A. *Civic Sociology*, revised edition. Yonkers-on-Hudson, New York: World Book Co., 1932. 415 plus xi pp.
6. Wallis, G. S., and W. D. *Our Social World*. New York: McGraw-Hill Book Co., 1933. 378 plus xiv pp.

Criteria for distinguishing biological statements and references on an objective basis were set up in the form of a key with alternatives listed by pairs, similar to those used in biological sciences to classify specimens. So far as the writer knows, this tool for distinguishing differences and classifying has not been applied to ideas expressed in language. The writer was led to construct and use such a key because of the lack of any method known to him of sorting ideas scientifically. For practice and to test for weaknesses in the key, it was criticized and applied to a sample passage by two high school biology teachers, both with some training in sociology, besides the investigator. These same biology teachers later checked the validity of analysis and classification of data.

Each source book was analyzed by reading, first rapidly, then slowly and carefully, then a third time to guard against omissions and casual misinterpretations. If a sentence or part of a sentence was judged to state or clearly refer to a biological concept or prin-

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ciple, it was marked in the book. After the last checking, each passage checked was copied on a separate slip of paper for classification under corresponding biology teaching objectives.

The passages were classified according to the list of 376 biology objectives compiled by Persing.¹ This list is the result of a study "to discover all the specific objectives in approved courses of study, textbooks, and curriculum investigations. . . ." The Persing list of objectives is much more detailed and extensive than lists usually found in the literature of biology teaching. It is undoubtedly a valuable step forward in defining biology objectives. The progress yet to be made in this direction is indicated by its limitations, some of which made it awkward to use for classifying the data of this study. The objectives range from very narrow to very broad. Objectives are grouped under main headings, but general and specific objectives are listed coordinately without distinction. In several instances two or more objectives appear with almost exactly the same meaning. Often related objectives are widely separated.

The slips containing items from source books were first classified under main headings, then under specific objectives. If no objective was found in the Persing list under the proper main heading to fit the item, a new objective was written in. No new objectives were added if it seemed possible to use objectives already in the list. Objectives added were patterned after those already in the list. New objectives were distributed under the main headings which they fitted, being placed at the end of the group of objectives already under that heading.

The total number of sentences in each book was estimated by counting sentences beginning on sample pages and multiplying the average number of sentences per page by the number of pages of text matter.

¹E. C. Persing. "Present Objectives in Biology." *Science Education* 17: 24-34; February, 1933.

Dividing this figure into the number of sentences containing biological items gave the per cent of sentences containing biological references.

To check for validity of analysis, a check judge and the writer applied the key independently to the analysis of a sample passage. (Chapter IX entire in Ellwood's *Social Problems and Sociology*.) The check judge listed 68 items as biological facts or references; the writer listed 64 items; the two agreed on 61 items. This last figure is compared with the 68 items of the check judge, giving 89.7 per cent. The 61 items on which the two agreed are compared with the 64 items of the writer, giving 95.3 per cent. Averaging these two figures gives 92.5 per cent as the agreement between the check judge and the writer.

To check reliability of analysis, a sample chapter was marked by the writer a second time, two weeks after the first marking. Per cent of reliability, as calculated by the same method used to determine validity, was 94 per cent.

Validity of classification was checked by independent classification of a random sampling of fifty items by the writer and a check judge. The agreement was 88 per cent.

To provide a check on reliability of classification, a sampling of 84 items was reclassified by the writer ten days after the first classification, with a resulting agreement of 96.2 per cent.

RESULTS

Table I shows the per cent of sentences referring to biology for each source book and the average for the group.

All together, 2878 passages were taken from source books. These were classified under 143 categories: 82 objectives from the Persing list, 60 added objectives, and one category for items not applying to objectives. The number of items under one objective from one source ranged from 1 to 85. The total number of items under one objective ranged from 1 to 150. The me-

TABLE I
PERCENT OF SENTENCES REFERRING TO BIOLOGY

Source	Calculated No. of Sentences in Book	No. of Biological References in Book	Percent of Sen- tences Re- ferring to Biology
1. Elliott . .	5627	421	7.4%
2. Ellwood .	4096	709	17.3%
3. Finney .	4909	459	9.3%
4. Gavian .	5486	720	13.1%
5. Ross . . .	3671	235	6.4%
6. Wallis .	3188	334	10.8%
Average.	4496	513	10.7%

dian frequency under one objective ranged from 0 to 23.5. The original table of data is not given here, because of its length and detail.

Table II shows a ranking of the sixty-four objectives corresponding to topics with a median frequency greater than zero.

All topics referred to by three or more writers appear in the table. Ranking by median frequency is considered by the writer most significant for final evaluation of objectives, as it shows the general consensus as to the importance of a topic. Of the sixty objectives added to the Persing list, thirty-three appear here, as shown by the asterisks in the table.

Lists were made showing the biological topics most frequently mentioned in each book, whether emphasized by other writers or not. Source book 1 (Elliot) emphasizes stages of human life, the use of alcohol, and emotions. Source book 2 (Ellwood) stresses evolution and the struggle for existence. Source book 3 (Finney) stresses psychological topics. Source book 4 (Gavian) stresses emotions and habits. Source book 5 (Ross) emphasizes heredity and health problems. Source book 6 (Wallis) stresses all the above topics except the psychological, without special emphasis on any one.

The first ten topics by individual frequency are also among the first twenty by median frequency, and the first eleven by median frequency are also among the high-

est thirteen by individual frequency. Two topics, heredity in man, and emotions, in that order, head both lists.

Since writers of the sources differ greatly in the emphasis put on biology and also in their choice of topics to emphasize, comparisons were made to see how topics most emphasized by each source book were treated in other source books. Great differences were evident in the treatment of most topics. A few were treated relatively uniformly, especially the following ones: race differences, heredity in man, emotions, causes and prevention of diseases, inherited defects and abilities, child health, industrial problems of health, and the value of medical treatment.

CONCLUSIONS

1. Sociology, at least on the high school level, has a basis in biology, to an extent indicated by authors' references to biological concepts or principles in one sentence out of ten.

2. Sociologists differ greatly in their use of biology as a basis for presenting sociological ideas, as shown by the variation in the proportion of biological references and differences in topics used.

3. Commonly accepted formulations of biology objectives may be made more valid by the addition of objectives valuable for social understanding, which have not been stressed or even mentioned at all.

4. A summarized answer to the question of what concepts and principles of biology are most used as a basis for sociology may be expressed in the form of an outline, with objectives organized under main headings. The eleven objectives listed below are among those ranking highest by both median and individual frequency, and therefore among the most important of the sixty-four listed in Table II. Main headings and objectives under them are in order of median frequency.

OUTLINE OF HIGH-RANKING OBJECTIVES

I. Health and disease

1. To appreciate the importance of health.

Rank

1

2

3.5

3.5

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6

7.5

7.5

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12.5

12.5

14.5

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29.5

* Add

TABLE II
RANKING OF OBJECTIVES ACCORDING TO MEDIAN FREQUENCY OF MENTION

Rank	Objective	Median Fre- quency	Rank	Objective	Median Fre- quency
1	To know about heredity in man*	23.5	29.5	To know the dangers of undernourishment and malnutrition*	3.5
2	To know the essential facts about emotions	19	32	To know civic hygiene	3
3.5	To know the meaning of habits	17	32	To appreciate the importance of agriculture*	3
3.5	To know about the inheritance of special defects and abilities*	17	32	To know about tuberculosis*	3
5	To know about race differences*	10.5	34	To appreciate the importance of medical research*	2.5
6	To appreciate the importance of health*	10	37	To know how to care for animals	2
7.5	To know how to keep children healthful	9.5	37	To understand the potentialities of increase in numbers by unchecked reproduction*	2
7.5	To know the characteristics of the stages in human life from infancy to death*	9.5	37	To know how to prevent epidemics*	2
10	To understand reproduction in man	9	37	To know the effects of using tobacco and alcohol	2
10	To know the causes and preventions of diseases	9	42.5	To know about sex differences in man*	2
10	To know about work, fatigue, and rest*	9	42.5	To know how the food supply limits numbers*	1.5
12.5	To understand adaptations	8.5	42.5	To know the structure and use of the sense organs	1.5
12.5	To understand struggle, selection, and survival*	8.5	42.5	To know about smallpox*	1.5
14.5	To know the industrial problems of health	8	42.5	To appreciate the value of physical examinations*	1.5
14.5	To know the value of medical treatment*	8	42.5	To learn how to prevent accidents	1.5
16.5	To know the nature of heredity	7.5	42.5	To appreciate the value of biology in understanding human relationships*	1.5
16.5	To know how to care for plants*	7.5	50	To know about the development of the human species*	1
19	To know how plants and animals react to stimuli	6	50	To know the food needed by the human body	1
19	To know biology and health	6	50	To know a properly balanced diet	1
19	To know methods of assuring the food supply*	6	50	To know why we should eat	1
22	To know the general functions of the body*	5.5	50	To know about venereal diseases*	1
22	To understand the nervous system	5.5	50	To know about pneumonia*	1
22	To know about variability in man*	5.5	50	To know how to conserve the forests	1
24	To know about race crossing*	5	50	To know how bacteria are injurious	1
25	To appreciate the importance of assuring the food supply*	4.5	50	To know uses of soils to plants	1
27	To know the characteristics of living things	4	59.5	To know how anthropoid apes live*	.5
27	To know the relative importance of heredity and environment	4	59.5	To know about group life of plants and animals*	.5
27	To know about the brain	4	59.5	To know about migrations of animals*	.5
29.5	To know the general structure of the body	3.5			

* Added objective, not in the Persing list.

TABLE II—(Continued)
RANKING OF OBJECTIVES ACCORDING TO MEDIAN FREQUENCY OF MENTION

Rank	Objective	Median Fre- quency	Rank	Objective	Median Fre- quency
59.5	To know how to control bac- teria .....	.5	59.5	To know facts about cancer..	.5
59.5	To know plants and animals as sources of useful materials.	.5	59.5	To know about epilepsy* .....	.5
59.5	To know the hygiene of respi- ration .....	.5	59.5	To know about typhoid fever*	.5
			59.5	To know how our bodies are controlled .....	.5

* Added objective, not in the Persing list.

2. To know how to keep children health-
ful
3. To know the characteristics of the
stages of human life from infancy
to death
4. To know the causes and prevention
of diseases
5. To know about work, fatigue, and
rest

II. Reproduction, heredity, and variation

1. To know about heredity in man
2. To know about the inheritance of
special defects and abilities
3. To know about race differences
4. To understand reproduction in man

III. Psychology

1. To know the essential facts about
emotions

2. To know the meaning of habits

5. This outline of high-ranking objectives and also the list given in Table II should be of use in modifying biology teaching. Insofar as the aim is to provide a basis for social understanding, the objectives in Table II may be considered reasonably valid. The objectives in the summarized outline may be considered as having high enough validity to rate as minimum essentials. Those being stressed in teaching may be stressed more confidently. Those not being stressed are worthy of serious consideration as to whether they should be stressed.

SOME NOTES ON SCIENCE TEACHING IN ENGLISH SCHOOLS*

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SCIENCE IN PUBLIC SCHOOLS

Similar, but even more rigid conditions existed in the Public Schools in which I was able to visit science classes. At Winchester, Eton and Harrow I had only the casual glimpse of conditions that the usual visitor gets. But in the Westminster School, Christ's Hospital (The Bluecoat School) and Charterhouse, I had a more intimate view of the science curriculum. At Westminster and Charterhouse, as would be expected in classical schools, science played a rather subordinate part in the curriculum. Physics and chemistry were emphasized at the expense of biological sciences. The

work done was of a high grade, with small groups. The passing of University examinations was the objective and the course was guided by the University syllabi for which the students were prepared. In Christ's Hospital, which has recently removed to a fine rural site near Horsham, the curriculum was much broader, an introductory year being given to general science (largely physics), a year to biology, and two to three years of physics, with chemistry last. Much more time was devoted to science here than in the other Public Schools visited. A survey of the school's history gives the reason for this. The Bluecoat School, so called from the dress worn by

* Concluded from the December issue.

the inmates, was founded by Edward VI as one of the five royal hospitals of the City of London.¹¹ Three of these, Christ's, Bridwell, and St. Thomas, were intended to provide asylums for the city's paupers, Christ's being set aside for young fatherless children. As early as 1555 it had won a respectable position as a metropolitan school. At the present time Christ's Hospital Foundation maintains two schools, one for boys at Horsham, and another for girls at Hertford. No children are admitted whose parents are not "in the opinion of the council, in need of assistance toward the education and maintenance of said child."¹² Candidates may be admitted by "presentation" by members of the Donation Council, of the Council of Almoners, of certain City Companies and by the Brodribb foundation for members of this family or they may take competitive examinations for scholarships. All expenses of education, maintenance and clothing of the successful candidate are paid by the foundation although "The council may at any time subsequent to the child's admission require a contribution or an increased contribution over and above £40 per annum, from parents or guardian whose circumstances have, in their opinion, so improved as to warrant such requirement."¹³ Obviously the graduates from the school do not have the advantages of wealth or family which are found in the great Public Schools. They must earn their living. Hence the curriculum places more stress on the practical side, mathematics, French, science and the commercial branches being emphasized. Some enter the navy under an ancient charter of Charles II and many go into commercial pursuits. But a long and honorable list of England's great scholars and poets comes from this school, Samuel Taylor Coleridge, Leigh Hunt and Charles Lamb among them.

¹¹ Staunton, H. *The Great Schools of England*. Sampson Low, Son and Marston, London, 1865.

¹² Regulations for Candidates for Admission, Christ's Hospital.

¹³ *Ibid.*, page 1.

THE CENTRAL SCHOOLS

Another type of English school is rapidly being established, especially in the larger city systems. This is the so-called Central School. This school has been brought into existence largely through the instrumentality of the "Hadow Report" which in 1926 advocated a "clean cut" in education at about the age of eleven years, there being a distinction between primary and post-primary education. It also recommended raising the age for compulsory attendance to fifteen years. While the more able children will pass examinations from the elementary school to enter the secondary school, the Central School will provide for the needs of those who are likely to enter non-professional occupations, commercial, industrial or rural. According to statements made by members of the staff of the Board of Education at Whitehall, boys entering the Central Schools are of higher intelligence quotient than those who go to the trade schools and often find themselves after a year or so, going on to secondary school and thence to the University.

I had the good fortune to visit the science classes in the Catford (London) Central School for Boys. There were two science masters, one instructing in physics, the other in botany or nature study. The science classes alternated between the two science rooms, one group working individually at a simple problem involving weights and measurements in the physics laboratory, the other group having group lecture-demonstrations in elementary plant physiology. Both physics and botany were given the same group at different periods on the same day, over half the school day being devoted to science. The science classes met two days a week. The youngsters were serious and interested, working hard at their problems. The physics master allowed time for writing up notes and measurements, criticizing the work done as he passed from boy to boy in the laboratory. There was considerable interest exhibited in the botany

room, the youngsters raising hands to volunteer answers, asking questions, and acting more like our junior-high-school boys. The teaching, though different in each of the adjoining rooms, in each case seemed well adapted to the age and mentality of the pupils, who evidently enjoyed both methods of teaching. It was a clear case of how the laboratory and lecture-demonstration methods may be used in science.

TRAINING OF SECONDARY-SCHOOL SCIENCE TEACHERS

As in our own country, great differences exist in the training of secondary-school teachers of science. While some have had University training and years of teaching experience, others lack these qualifications, especially in the smaller schools. Teachers in government-aided secondary schools are not required by statute or regulation to have any specific qualifications. The Board of Education's simple requirement is that the teaching staff must be suitable. As a matter of fact, a large and steadily increasing proportion of teachers are university graduates. This is particularly true of science teachers, who, I would say, on the whole have more hours of training in their specific subject matter than do our secondary teachers of science. The teacher training departments of various universities provide a one-year course of professional training for teachers, in addition to the three years spent in the University. If we contrast this with our own teacher training program, we can see that the English secondary-school teacher has the advantage of at least an extra year at the university level, since their upper secondary school is equivalent to our junior college. Most of the science teachers I met in the secondary schools were far better trained in special subject matter than our own secondary-school men, although they seemed not so conversant with educational theory and techniques. This is to be expected when one considers the objectives of science in the English secondary school.

CONTRASTS BETWEEN AMERICAN AND ENGLISH SECONDARY SCHOOLS

While it is difficult to give more than general impressions, certain characteristics of the English secondary schools stand out:

(1) In the first place their membership is a picked group, selected by competitive examination and hence more serious application to work. The English boy works when he works and plays when he plays, but he does not mix the two as does our high-school product.

(2) The University has a stronger hold on the secondary school than do our colleges and universities. While this makes the objectives of English education clearer to both master and pupil, it does not allow for the socialization of the school program. The University-dictated courses of study allow much less freedom than in our secondary schools and although there is more latitude within the individual school in choice of area of science covered, this independence is only apparent because of the University-dominated syllabi and examinations. The core curriculum of the English secondary school is still English, foreign language, plus mathematics and science with some slight choice of electives. Hence the English secondary-school boy devotes more time per week to fewer subjects than do our secondary-school youths.

(3) One has the impression that biology is displacing botany and zoology in the English secondary schools. The last ten years have shown rapid progress in this respect. While Oxford and Cambridge still set separate papers on zoology and botany, they lay emphasis on interrelations between the two subjects. All seven of the examining bodies in England offer examinations in biology, although their syllabi differ greatly from similar courses of study in our secondary schools.

(4) The secondary schools are much smaller than our schools in both urban and rural areas. An average school has about two hundred fifty pupils, five hundred is a large school. This results in a more homo-

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geneous population and in smaller classes than in our schools. This was particularly noticeable in science in the upper forms, where classes rarely exceeded fifteen and more often consisted of from six to ten boys.

(5) There is a noticeable absence of the bustle and hurry seen in the American school. More time is given for passing and since the buildings are small, classes reach their destination in plenty of time to have distribution of materials and all the routine checking done without haste. There is no boisterousness or loud talking in the halls and in both classroom and laboratory there is sober attention to the work in hand. The masters appear to be unhurried and serene; while they do not have as many free periods as we have in our better organized schools, they always seem to have time to talk with students and to help them with their individual work.

(6) In all secondary schools we find a distinctive dress or uniform. Often it is only a cap, more frequently a distinctly marked blazer or coat in color with school insignia emblazoned on the front. In all girls' schools visited a uniform was worn. In the grammar schools a scholastic cap and gown is used. These are taken off in the laboratory but are worn on the street. In the Public Schools distinctive dress is seen, as the Eton jacket of the lower forms with morning coats and "toppers" of the upper forms at Eton. The Harrovians had blossomed out in broadbrimmed straws and light flannels on the summer day we visited their campus. In many of the church schools, such as Westminster, the cap and gown is commonly worn. Almost invariably the masters wear gowns except in the laboratories.

(7) The emphasis in science teaching is on individual laboratory work. All of the schools visited had laboratories as well as classrooms and in most cases a lecture room with projection lantern. The rooms are small, laboratories rarely seating more than twenty-four students. Frequently in the biology room, student demonstration desks were built in under the windows. The phys-

ical apparatus often seemed deficient in amount and in many schools boys in the upper forms worked in small groups or on individual problems because of the scarcity of apparatus. The lecture-demonstration is used, but to a much less extent than we recommend on this side of the water. Laboratory work in the biological sciences places much more emphasis on taxonomy and morphology than on physiology and ecology. Texts appear to be less used than in our schools, being largely used for reference, rather than for assigned "recitations." Biologies, rather than botanies or zoologies, seemed to be in the ascendant. I noticed some American texts reprinted for use in England, but these were apparently only used for reference as they did not fit into the English biology syllabi. Workbooks and other helps were virtually never used although in some schools mimeographed sheets of botanical drawings were given out to be labeled in the laboratory. Charts and models were on the whole deficient, both in quality and quantity. Every school visited had a few good microscopes and adequate dissection apparatus and materials.

(8) Apparently considerable use is made of holidays and week-ends for trips and excursions. Many schools have organized trips of several days each to historical monuments near the school. More than once we met, when visiting museums, castles, or Public Schools, small visiting groups of boys in charge of a master.

(9) The English secondary school has ideas and ideals on science quite distinct from those held in our secondary schools. While they are not thinking in terms of socialized science and integrated programs, they are laying a very solid foundation in certain core subjects, foundations which are built on a pattern which resembles our science teaching about ten years after the report of the Committee of Ten, but which pattern nevertheless makes the products of the English secondary school able to become, after three years of university training, educated men. Does our secondary-school education do this?

SCIENCE CLAIMS IN MAGAZINE ADVERTISING

TREFFIE COX, J. S. MCCOLLUM AND RALPH K. WATKINS

University of Missouri

One of the predominant objectives of many of our high-school courses has been the attempt to influence the thinking of the pupils undergoing training in the courses. More recently we have become rather acutely aware of the need to attempt to establish, or change, the attitudes of the people being trained in such courses. How far short we have fallen in attaining these objectives in much of our science teaching may be shown by demonstrating the gullibility of the public in general, many members of which have had training in high-school science courses, to pseudo-scientific claims in advertising.

Much has been said concerning the rights of the consumer, the protection of the consumer, and the exploitation of the consumer. To what extent does the consumer need protection? How much of his need for protection is due to lack of attitudes of scientific inquiry concerning the products which he buys? How much is possibly due to the fact that the typical consumer has never been taught to think in the problem-solving situations set up by claims of value in the sales promotion of ordinary commodities? How much may be due to the fact that the kind of scientific information possessed by the consumer is not the kind of information that can be brought to bear directly upon problems in which he needs protection from sales exploitation? How much of the consumer's dilemma is due to the fact that he has not been trained to know where to find reliable sources of scientific information by means of which he can check the claims in sales propaganda?

The psychological reactions of the people concerned seem not unlike the reactions to common superstitions. Belief in the advertised product is deeply rooted in our American *mores* and most assiduously cultivated both by the sellers of commodities and the purveyors of advertising. A widely adver-

tised article is better than one less widely advertised. A trademarked article is better than one without a trademark. The distributor says the product is good, therefore, it must be good. "Science says" that this face cream contains vitamins, so it must be good for the skin. This food has been tested in the "laboratory" of a widely circulated women's magazine, so it is the food that I should buy. This soap has the endorsement of a famous beauty, it must then make me beautiful. And so it goes. Are these not just as much superstitions as the belief in lucky and unlucky numbers, the carrying of horse chestnuts for rheumatism, or rubbing a rabbit's foot for luck?

How much of this problem falls within the field of the natural sciences? To what extent may it become the problem of the science teacher? To what extent are supposedly scientific claims for products made in popular advertising? In what areas of science, or applied science, do these claims fall? To what extent are the claims true, if judged by well-established facts or principles in the sciences? Are there investigations of the claims for some of these commodities made by impartial investigators by valid scientific techniques? What do these investigations show?

It was proposed by the investigators to examine a limited amount of general advertising to find just what products were propagandized by claims that might be considered as having a basis in the findings of the natural sciences, and to determine the extent to which such claims might be valid when compared with findings in presumably scientific literature not under the control of the manufacturer nor the seller of advertising.

The workers included two students in the Graduate School of the University of Missouri, Treffie Cox and J. S. McCollum, working under the direction of the senior

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author. Mr. Cox and Mr. McCollum gathered the claims in the advertising and checked these against the sources in scientific literature. The general planning and the summation of the results were done by the senior author.

The investigation was limited to magazine advertising because of the easy availability of the material and the wide-spread infiltration of such material into the lives of a very large number of people. It is probable that the magazines chosen reach a somewhat selected group with rather better general education than that of the mass of American people. Newspapers could have been used, but newspaper material is not so readily accessible nor so easily handled as magazine material.

The Saturday Evening Post was selected for the first work on the assumption that it is the most generally popular and widely distributed advertising medium among the magazines of the United States. The others were used in order to determine whether or not other special advertising could be found in women's magazines, a farm journal, and a house and garden magazine, that did not appear in the first magazine. The choice of particular magazines within these fields was largely determined by the easy availability of materials for the investigators.

All of the advertising in the following magazines was examined by Mr. Cox:

The Saturday Evening Post, Jan. 13, 1933-Jan. 20, 1934, 52 issues.

The Ladies Home Journal, Jan. 1933-March 1934, 14 issues.

Good Housekeeping, Jan. 1933-Dec. 1933, 12 issues.

McCalls, July 1933-Jan. 1934, 6 issues.

Country Gentleman, Jan. 1933-Dec. 1933, 12 issues.

Better Homes and Gardens, July 1933-Jan. 1934, 6 issues.

The survey of issues of *McCalls* and *Better Homes and Gardens* was discontinued at six issues when it was found that further examination yielded neither new advertising nor new claims. Mr. Cox's work was done during the winter of 1934.

In the winter of 1935, Mr. McCollum picked up the work. He extended the survey begun by Mr. Cox to include the following:

The Saturday Evening Post, Jan. 20, 1934-Jan. 12, 1935, 52 issues.

McCalls, Jan. 1934-Dec. 1934, 12 issues.

Country Gentlemen, Jan. 1934-Dec. 1934, 12 issues.

When it was found that most of the claims in all of the magazines fell in the areas dealing with foods, medicines, and antiseptics, Mr. McCollum summarized the reports of the *Journal of the American Medical Association* for such commodities in volumes 102, 103, and 104, January, 1931, to December, 1934, of the *Journal*.

In carrying out the investigation, a reader canvassed all of the advertising in an issue of one of the selected magazines. In reading an advertisement, if any claims were made for the product that seemed to depend upon scientific findings, or claims that seemed verifiable in terms of existing scientific information or principles, the advertisement and its claims were listed on a card. Each advertisement was placed on a separate card. The space below the listed claims was left for a record of the check upon the claims made later. The data recorded included the name of the commodity, the claims made for it in the advertising, the name of the magazine in which the advertising occurred, and the date of the issue. For example:

Rinso

McCalls, April 1934, p. 147

Claims:

1. Dirt floats off by itself
2. Clothes last 2 to 3 times as long
3. Easy on the hands
4. Long lasting suds, even in the hardest water

No record was made of the frequency of occurrence of advertising, or of claims for a particular trademarked commodity. After the advertising for a particular brand of one commodity had been noted, no further treatment of this particular article was made unless new advertising involving new claims

for it occurred later, or in another periodical. Frequency records involve only the extent to which the same kinds of commodities are advertised by different sellers, or the same or similar claims are made for similar products.

As the cards with records of advertised commodities and their claims were accumulated, they were grouped into classes determined by the uses made of each commodity. By this means it was possible to determine in which areas the scientific claims in advertising fall. These areas indicate the points at which the consumer needs the greatest amount of protection. They serve to indicate also the points at which the high-school or college science teacher may stress problems for training individuals to meet situations growing out of such claims.

The areas of the more frequent claims are listed below:

Areas of the More Frequent Scientific Claims in Advertising

1. Foods in general
2. Beverages
3. Tooth pastes and dentrifices
4. Mouth washes and antiseptics
5. Antiseptics for cuts, wounds, and abrasions
6. Pain relief, chiefly headache remedies
7. Yeast preparations
8. Laxatives
9. Baby foods
10. Hair dyes
11. Hair tonics
12. Face creams and skin ointments
13. Face powders
14. Deodorants and depilatories
15. Cough remedies
16. Cold treatments
17. Cod liver oil (vitamin D preparations)
18. Foot treatments
19. Treatments for animal diseases
20. Soaps
21. Cleaners for plumbing and woodwork
22. Floor, furniture, and automobile cleaners and polishes
23. Chemicals for cleaning drains
24. Antifreeze preparations for automobile radiators

A more general classification might reduce this to foods, antiseptics, patent medicines, cosmetics, soaps, and chemical cleaners. There are included areas indicating

some of the very common human frailties and superstitions.

An interesting phase of this classification is the absence of certain types of widely advertised commodities. These include such things as automobiles, automobile accessories, radios, refrigerators, electric appliances, and clothing.

It is possible that a different group of magazines might show a different emphasis upon the commodities advertised. Certainly the women's magazines used would catch the clothing advertising in magazines. It is probable that newspapers are far greater advertising media for clothing than magazines. Much of the present advertising dealing with air conditioning and insulating materials for house building did not appear in these magazines two years ago.

It must be remembered that only those pieces of advertising were recorded that in the opinions of the readers could be traced back to a possible verification, or lack of verification in scientific literature. Much of the automobile advertising is not of this type. The scientifically verifiable claims are few. For example, the following is quoted from a recent double page automobile advertisement in *The Saturday Evening Post*. "America's quick to spot a winner. . . . And it's the only low-priced car with all the vital engineering features of the high-priced cars. . . . Both have the famous . . . 'Twin-Ignition' engine." What can a scientist do with this? Or try this one. "Our brake lining is the safest kind of lining." Much refrigerator advertising is of the same sort. This refrigerator keeps food safe for more years at a low cost. Advertising of this kind was omitted from the study due to the generality of the claims and as being unverifiable without expensive and elaborate testing of the commodities themselves. Such testing was of course outside the scope of this investigation.

The kinds of advertising claims recorded and checked can be shown by the following illustrations.

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Common claims in yeast and yeast tablet advertising are:

1. Clears the complexion
2. Cures constipation
3. Helps prevent colds
4. Cures headaches and nervousness
5. Purifies the blood

Some frequent claims in food advertising follow. Many foods claim an especially high vitamin content. The addition of iron to prepared foods is claimed to be an aid to health. Bran advertisers say that it is a general cure for constipation. One prepared cereal is advertised as quick digesting, and as supplying energy faster than any other type of cereal. It also claims to build up a resistance in a child and to keep him free from strain and irritability. Another cereal advertiser makes the following claims:

1. Exercises the teeth and gums
2. Supplies roughage for better digestion
3. Is good for the complexion
4. Prevents constipation
5. Contains vitamin B for growth and resistance to disease
6. Is easy to digest because of the shape of the fibers

A manufacturer of syrup claims for it the following:

1. It is energizing rather than fattening
2. It makes other foods, e.g., pancakes, more quickly available as digested food
3. It quickly turns to energy

Orange advertising claims for oranges the following properties:

1. Oranges contain large amounts of vitamins A, B, and C, and of calcium
2. Oranges help to arrest tooth decay and gum troubles
3. Oranges improve an individual's resistance to infection, aid digestion, promote growth, and stimulate the appetite

Tomato juice advertising makes almost identical claims.

Mouth washes and similar "antiseptics" claim to prevent colds, cure sore throats, banish halitosis, and prevent infection in all kinds of minor cuts and wounds.

Typical claims for face creams and ointments are:

1. Remove blackheads and pimples
2. Remove wrinkles permanently
3. Change the texture of the skin to that of youth
4. Restore lost moisture to the skin
5. Nourish the skin
6. Correct dryness and roughness of the skin
7. Remove dirt and lift it out of the pores of the skin

There is not time nor space to quote more than a few claims from some of the areas in which the advertising occurs. The average reader is familiar with much of the material.

The process of validation of these claims was that of referring each claim to established facts or principles available in scientific literature. If the known nature of the commodity was such that the claims for it agreed with established scientific ideas, the claim was accepted. Standard references and some popular books of good repute, and periodicals were used as sources. Many of these were of the kind that are accessible to the layman. Most of them can be found in any adequate public library.

Illustrative sources for verification are as follows:

- United States Department of Agriculture, *Farmers Bulletins* (various titles)
Journal of the American Medical Association
Hygeia
Research Quarterly of the American Physical Education Association
Annals of the American Academy of Science
Science News Letter
 Adams, Samuel H., *The Great American Fraud*
 Chase, Stuart, and Schlink, F. J., *Your Money's Worth*
 Childers, Eleanor, *Effects of Coffee* (M.A. Thesis, University of Missouri)
 Fisher, Irving, and Fisk, Eugene, *How to Live*
 Kallett, Arthur, and Schlink, F. J., *100,000,000 Guinea Pigs*
 McCollum, E. V., and Simmons, Nina, *Newer Knowledge of Nutrition* (Revised)
 McGowan, E. B., *A Comparative Study of Detergents*
 Stieglitz, J. O., et al., *Chemistry in Medicine*
 The Engineering Foundation, *Popular Research Narratives*

In most cases no attempt was made to run cases back to primary sources in reports of original research. For careful and exact

evaluation, this would be a better procedure, but much more expensive and time-consuming. It was considered better practice, in terms of the purposes of this study, to use sources ordinarily considered reliable, but which can be secured and read by many laymen, or by the majority of high-school science teachers. This procedure has the additional advantage of producing material that can be used quite directly in high-school science classes without further elaborate modifications in language and form.

Necessary inferences for making application of the established facts or principles of science to the claims in the case at hand were made by the investigators. No apology is offered for this part of the procedure.

Some sample evaluations of claims are shown by the following cases. The claims for the first of the cereals quoted above may be resolved as follows: (1) There are no appreciable differences in the digestibility of the common cereal grains. Any difference in the digestibility of cereal starches probably favors rice. The cereal in question is a wheat cereal. (2) The digestibility of the cereal depends more upon the way in which it is cooked than upon the nature of the cereal itself. This particular cereal has no special advantage in this respect over a wide variety of other cereals. (3) Milled cereals are not complete foods. There is nothing about cereals as such that would tend to build up a child's resistance. Good feeding in general might help to do this. Such good feeding depends upon a well-balanced diet in which cereals of any kind are only one factor.

All of the claims for the second cereal mentioned, except the vitamin B claim, center around the issue of roughage in its relation to the prevention of constipation. The exercise of teeth and gums depend upon the rough nature of this particular cereal. The production of better complexions is dependent upon the possible effect of the food upon elimination. The encouragement of all kinds of people to eat large quantities

of cereal roughage is a dangerous practice. Some people can handle little roughage of this kind. Some few cases of constipation are helped by cereal roughage. Others are irritated and more harmed than helped. Human beings need less roughage than do many of our domestic animals. Too much cereal roughage may lead to intestinal disorders and indigestion.

The claims for the syrup quoted are interesting. Whether or not a carbohydrate food such as a syrup is energizing rather than fattening depends upon the condition of the individual eating the food. For many people such a food added to other foods would undoubtedly add to a tendency to increased fat. Whether or not this is true for a particular individual depends upon the condition of that individual at the time that the food is eaten. In other words, this depends upon the individual concerned and varies with the same individual from time to time. The claim that a syrup increases digestibility of a starchy food to which it may be added seems false. The only possible effect would come through the increased flow of digestive enzymes brought about by the syrup. This seems very doubtful. It is largely true that syrups containing glucose are readily digested and may be turned into energy in the body.

By grouping the advertising and the claims into the areas listed earlier in this article, it was found possible to make a general summary of validations of the claims for the advertising in a particular area. The following samples will illustrate this attempt.

Beverages. Coffee advertisers claim that no bad effects are possible from the use of special types of treated coffees due to the fact that they have had the caffeine removed, or that fresh coffees are harmless. Decaffeinized coffee does not have the bad effects of ordinary coffee. The amounts of caffeine remaining in decaffeinated coffees are variable. Sometimes such amounts are proportionally high. Special health claims for fresh coffee would seem to be pure nonsense. There may be something to the claim of improved flavor for fresh coffee. This has nothing to do with its healthful or non-healthful properties.

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Some widely advertised soda fountain drinks, tea, and coffee all contain essentially the same drug, caffeine. This is a nerve stimulant and should not be taken by individuals who are nervous, or who find it hard to sleep after taking such beverages.

Special claims of some sleep-producing and nerve-calming beverages to curb nervousness, increase the appetite, and cause a gain in weight, are largely false. Milk is a more efficient food than any of them and in addition is more economical. Warm milk taken just before retiring has the soothing sleep-producing effect desired for many people.

Tomato juice has a relatively high vitamin content as compared with other cooked vegetables.

Grape juice has been falsely advertised as having reducing properties.

Fruit juices of all kinds are of use in the diet when the price is not exorbitant.

Face creams and skin ointments. As a rule face creams are highly over-advertised and many of the claims are obviously false to any

intelligent observer. Lotions have some values in soothing a chapped skin. Otherwise the effect of this whole class of preparations is largely temporary and psychological in nature.

Cases have been known where the condition of acne has been improved by keeping the skin in a mild chapped condition. Oily face creams would be a hindrance rather than a help in such a condition.

No preparation on the market can magically change the texture of the skin, especially the texture from that of age to that of youth.

The skin is nourished from the food supply carried by the capillaries from within. There is no known means for feeding the skin from the outside. Skin nourishing creams would seem to be quite obviously false from the very first premise involved.

Some few products in this area have been put on the market which contained dangerous drugs. Those most likely to be found in face creams are mercury compounds, lead compounds, and salicylic acid.

(To be concluded in February issue)

WHY NOT USE CONTROL EXPERIMENTS?

PHILIP B. SHARPE

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The experiment is an integral part of the scientific method.* Its function is to give a definite and conclusive answer to a definite and debatable question. It bears the same relation to the hypothesis as the eating does to the pudding.

Everyone will agree that the experiment is the heart of the scientific method, the thing that pragmatically proves or disproves theories, the act that differentiates the scientist from the theorizer.

Aristotle's belief that bodies fall with a speed directly proportional to their weight was perfectly logical and acceptable for about 1,600 years until Galileo devised an experiment which proved that all bodies fall at the same rate, barring wind resistance. Lamarck's conception of the inheritance of acquired characteristics is most convincing, except that it has never been proved by experiment. And the flatness of the earth

*The Scientific Method referred to is the Experimental Method, as described in the Encyclopedia, illustrated in Newton's *Principia*, and exemplified in the work of Galileo, Faraday, and hundreds of others.

was self-evident until Magellan, Drake and others sailed completely around it.

These few examples will suffice, although history is studded with such. A theory without experimental confirmation is only a notion; without the experiment there is no certainty, or even probability, but only a possibility of truth.

The function of the experiment, then, must be to answer a definite and debatable question, such as: (1) Does air occupy space? (2) Does air have weight? (3) Does air exert pressure?

It will be apparent that many so-called experiments, foisted on pupils for teaching purposes, are not experiments at all.

If an experiment does not answer a definite and debatable question, it is not an experiment and not a part of the scientific method of discovering truth, but something else. It may be a technical trick, such as, (1) How to prepare oxygen, (2) How to make a mercury barometer, (3) How to soften hard water; or merely observation, such as, (1) To study the air, (2) The

Scientific Method Experiment Sheet

Date *March 4, 1937*Name *May Houghton*Question *Will Aspirin keep cut flowers fresh longer?*

Main Drawing



Control Drawing



Main Steps

1. I mounted some freshly cut flowers in water containing aspirin, as shown above, and observed at four times a day

Main Steps

Main Observations

1. Faded noticeably the third day

Main Observations

Control Steps

1. I mounted some freshly cut flowers in ordinary water as shown above and observed at four times a day

Control Steps

Control Observations

1. Faded noticeably the third day

Control Observations

Answer *No, aspirin does not keep cut flowers fresh longer*

BECAUSE 1. The aspirin treated flowers faded just as quick as the untreated flowers

THE CONTROL SHOWS that there was nothing to affect the duration of the aspirin flowers that would not also affect the untreated flowers, except the aspirin. No other variables

properties of water, (3) The use of a fire extinguisher; or a demonstration, such as, (1) How man uses various forms of energy, (2) The cause of sound, (3) To show how oxides are reduced.

Many techniques, observations, and demonstrations have titles like those of experiments, but a discerning reading of the report will show their real nature. Here is a brief example from a popular general science review book.

What Percentage of the Air Is Oxygen?

Procedure

Moisten the inside of a test tube with water and sprinkle some iron filings into it. Place the test tube, mouth down, over the water. Leave it all night.

Observations

Reddened particles are seen where rusting has taken place; however, many iron filings are still dark gray. Water is found to have ascended about one-fifth the total height of the test tube.

Conclusion

This shows that one-fifth of the air in the test tube is oxygen. This oxygen when combined with some iron filings forms rust. The remaining gas in the test tube is nearly pure nitrogen.

With as little regard for logic, other "conclusions" could be drawn from this experiment. It might be that the water dissolved one-fifth of the air in the test tube. It might be that the air in the test tube was warmed sufficiently by handling to expand one-fifth in volume, only to cool and shrink one-fifth later and so draw the water up in the tube.

Therefore, the experiment is not conclusive. It contained no control to eliminate these other alternatives, and so is no experiment at all, but just a demonstration to be taken mainly on faith. A fairly safe rule is: *No control—No experiment—No proof.*

Here is another example from a popular general science review book.

What Compounds Are Formed When Common Fuels Are Burned?

Procedure

Light a candle. Pour some cold water in a beaker and dry the outside surface carefully. Hold

the beaker a few inches above the flame of the candle.

Observations

Drops of water accumulate on the outside surface of the beaker.

Conclusion

The water resulted from the combination of the hydrogen of the candle with the oxygen of the air.

One can often get these results without even lighting the candle! Therefore what conclusion? It might be: (1) Glass is porous, (2) Glass is deliquescent, (3) Slow oxidation takes place in an unlighted candle, or (4) The cold water cools the air of the room below the dew point.

These few examples should illustrate the point sufficiently. One can find more cases readily enough. In fact, the amazingly hard thing to find is a true experiment; one that definitely and conclusively answers the question it undertakes.

It would seem advisable to modify our conventional experiment report form to make it require: (1) A definite question, (2) A definite answer, and (3) At least one control.

It is apparent that the present laboratory experiment report form does not sufficiently comprehend the function of the experiment in the scientific method. Indeed it seems to lend itself too readily to chicanery.

It is only common sense to try other forms until a better one is found, and it is only honesty to call nothing an experiment which does not really perform the function of an experiment in the scientific method, that is, to give a definite and conclusive answer to a specific and debatable question.

While the limitations of practical teaching may ordinarily restrict the secondary-school science experiment to one control, at least for conscience sake, let there be that one control in proper form.

Appended to this article is a suggested form, filled out to show its manner of use.

There are indications that the extra time involved in conducting scientific experiments in the scientific way will be well repaid in heightened interest, better reten-

tion, and also, perhaps, more thoughtful use of the text. If one regards such an investigation as easily the equivalent of two of the conventional kind, there is no sacrifice in any sense.

There has not been time and opportunity as yet to perform controlled experiments

testing the theoretical superiority of this experiment sheet in teaching genuine experimentation, but such work will be done.

It is hoped that some of the readers of this article will communicate with the author and cooperate in testing this form.

BIOLOGICAL INSTRUCTION CONCERNING PUBLIC HEALTH*

N. E. BINGHAM

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Much stress has been laid upon health as one of the important general objectives of education. During the past twenty years various commissions¹ undertaking the revision of the secondary school curriculum have stressed this objective. Doctoral dissertations² dealing with health instruction at the secondary school level have stressed the rôle which general science and biology may play in this connection.

Cairns tells us that, "the chief responsibility for health instruction should not be placed on the physical education departments. They have other objectives than health and cannot take time from their activity programs to give pupils the scientific background necessary for intelligent health practices. Any attempt to assume this responsibility by groups other than

those prepared to teach the underlying principles and having laboratories where pupils may have first-hand experiences, results in dogma instruction. The present survey shows, then, that except for physiology, biology and general science include more of the essentials of health instruction than any other subject. This would seem to indicate that biology and general science, since they are more widely offered than physiology, are best able to carry the major responsibility for health instruction."³

The inclusion of more materials concerning the nature and control of disease in our newer biology textbooks gives further evidence of this trend.

Accompanying the extension of improved methods of education and the extension of secondary school education to a larger proportion of the population, has come an increased demand for study material directly related to the needs of everyday life. Pupils are more and more questioning the purposes of the courses which they study. They wish to see the relation of the things they are learning to real life situations. The opportunity of studying and understanding the way various agencies cooperate in maintaining the health of a community gives these students the thrill of sharing cooperatively in a vital experience directly related to their own welfare. Such education seems eminently worth while to them.

³ Cairns, Laura, *op. cit.*

* Paper presented at Tenth Conference on the Education of Teachers in Science, Teachers College, April, 1937, New York City.

¹ Commission on the Reorganization of Secondary Education, 1918. Fifth Year Book of the Department of Superintendence of the N. E. A. Committee on the Teaching of Science in the Thirty-first Yearbook, N. S. S. E. Commission on the Secondary School Curriculum of the Progressive Education Association, 1937.

² Bureau of Educational Research in Science, Teachers College, Columbia University. 1936.

Cairns, Dr. Laura, *Scientific Basis for Health Instruction in the Public Schools*. Berkeley, California, Publications in Education, Vol. 2, No. 5, California University, 1929.

Laton, Dr. Anita, *The Psychology of Learning Applied to Health Education through Biology*. New York: Bureau of Publications, Teachers College, Columbia University, 1929.

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Thus it seems clear, from the standpoint of the objectives of education and from the standpoint of pupil interest, that essential generalizations related to health should be studied in biology classes by means of first-hand laboratory and field trip experiences. The purpose of this article is to present a teaching plan for the attainment of the above goals. This plan has been found workable. Some of the material presented is particularly adapted for use in New York City. However, the same approach could be made elsewhere using statistics applicable to the local situation.

The study materials were organized around the following problems: What are the chief causes of ill health? How is our health department organized and how does it function? How have we, and to what extent have we, conquered disease? What is the nature of microscopic organisms and what conditions favor or limit their spread and growth? How does the body protect itself from disease? How do we prevent the spread of disease? How do these worst diseases affect us and how do we combat them? How can we improve the health of our community?

To determine the chief causes of ill health we turned to the vital statistics of New York City Health Department. The accompanying list gives the number of

cases of reportable infectious diseases in New York City during 1935 and 1936 as well as deaths from these same causes for the years 1935 through 1937 as far as available.

Colds are so common that they are not reportable. However one gets a pretty clear picture of the number of new cases of the serious preventable diseases from the above table. Nearly half of the reported cases were venereal diseases. Syphilis and gonorrhea present a formidable total in numbers and in suffering caused. Certainly biology students will want to know about these diseases and their prevention. Pneumonia and tuberculosis are dread diseases as is shown by both the number of new cases and the high death rate for each. Measles and scarlet fever rank high in number of new cases. It is important to know about these diseases. Chickenpox is hardly serious enough to warrant much study even though there are many cases each year. Diphtheria seems worthy of study since we know how to prevent it entirely. Typhoid fever is interesting to study as a record of the splendid work of the health department in conquering this disease.

Since the health department has so much to do in safeguarding our health, one really cannot understand how diseases are con-

	<i>New cases of reportable infectious diseases during</i>		<i>Deaths from these diseases during</i>		
	1935	1936	1935	1936	1937
Syphilis	47,659	68,969	—	—	—
Measles	28,490	36,548	105	81	25
Pneumonia	13,185	15,786	6,385	6,549	6,505
Gonorrhea	11,069	14,445	—	—	—
Scarlet Fever	14,602	11,417	76	63	31
Pulmonary Tuberculosis	8,796	8,987	3,968	4,169	3,931
Chickenpox	10,866	8,324	?	?	?
Whooping Cough	8,703	4,461	148	49	49
Influenza	622	1,396	295	293	—
Diphtheria	1,189	1,124	68	35	58
Epidemic Meningitis	529	538	243	226	—
Typhoid Fever	314	305	34	33	26
Poliomyelitis	2,054	34	91	9	18
Epidemic Encephalitis	69	37	243	226	90

trolled in an urban civilization without knowing about the organization of the health department.

The New York City Department of Health functions through thirteen separate bureaus, namely, Preventable Diseases, Tuberculosis, Social Hygiene, Nursing School Hygiene, Child Hygiene, Laboratories, General Administration, District Health Administration, Health Education, Records, Sanitation, and Food and Drugs.

The work of the Bureau of Laboratories illustrates well the application of science in the maintenance of health. Bacteriological examinations of water, milk, food and drugs are made as a matter of routine. Doctors all over the city send specimens from patients for diagnosis thus enabling them to give the best specific treatment available. For instance, a patient ill with pneumonia must have the right treatment quickly if it is to prove effective in helping him fight the disease. Normally the crisis comes the third day and any serum to be of help must be administered early in the course of the disease. The patient may have any of thirty-two different types of the disease. The only serum which can help him is the one for this specific type. As soon as a doctor is called he collects a sample of sputum, sends it to the health department, and within an hour's time the type is determined and the correct serum, if available, is on its way to the patient. This new service promises to do much to lower the present high death rate from this disease.

Other activities of the Bureau of Laboratories are the manufacture of antitoxins and vaccines in quantities for use in the city and elsewhere, and improving methods to be used in controlling diseases through the work of their world famous research laboratory.

High-school biology students are thrilled by a trip to the Bureaus of Records, Laboratories, Preventable Diseases, and Food and Drugs, of the Department of Health if such a strip can be arranged. If not, a

trip to visit a hospital where some of these same tests are made should prove interesting.

Quarterly bulletins, annual reports and pamphlets from your health department should be helpful. Also a good reference on public health and hygiene⁴ should prove valuable.

The accompanying chart gives one picture of our conquest of disease. One is appalled at the death rates in 1832, 1849 and 1854 when cholera devastated the city. No city could survive with such high death rates. Even during the better years the death rates ran around 25 per thousand or about one out of every forty inhabitants. Contrast this with the present death rate of 10.4 per 1000 population.

Many of you remember the pandemic of influenza in 1918, yet conditions existing during that pandemic were far superior to those before 1881. In 1881 Dr. Hermann Biggs, Commissioner of Health of New York City organized and established the first research laboratory in connection with any health department. Undoubtedly much of the decline in the death rate can be attributed to its findings.

If we reflect upon the practices of doctors in New York City up until that time we find that about their only method of treatment was through the use of quarantine and drugs. The germ theory of disease was almost unknown.

Much of the early work of the research laboratory was concerned with the testing of publicizing among medical men of the recent findings of Koch, Pasteur, and others. This hastened the general acceptance of the germ theory of disease and with it brought a realization of the importance of sanitary measures in the prevention and control of disease. This gave impetus to the safeguarding of the water and food supplies and to the removal of waste from within the city. Survival de-

⁴ Bolduan, C. F. and Bolduan, N. W., *Public Health and Hygiene*, 2nd edition, 371 pages, illustrated, \$2.75, Saunders, 1936.

DEATHS REPORTED PER 1,000 POPULATION

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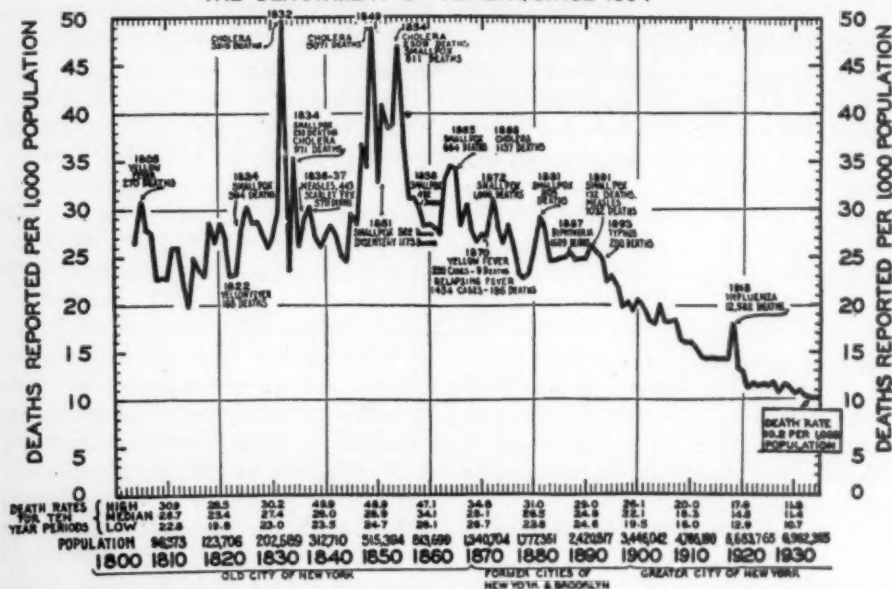
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THE CONQUEST OF PESTILENCE IN NEW YORK CITY

DEATH RATE PER 1,000 POPULATION, FROM OFFICIAL RECORDS OF THE DEPARTMENT OF HEALTH, SINCE 1804



mandated that the city carry out these measures.

This picture stimulates one to investigate health through the ages, and to contrast beliefs and superstitions prevalent then with modern ideas of disease. One naturally traces the early developments in the scientific control of disease and hence, is led to the study of the lives and works of Jenner, Pasteur, Koch, Nightingale, Reed, Trudeau, and others. The work of these pioneers is as thrilling as any modern fiction.

An interesting class activity in connection with the above is to plot the histories of several diseases during the past thirty years showing the trend of the disease with its epidemic recurrences. Several

DeKruif, Paul. *Microbe Hunters*, Harcourt Brace, N. Y., 1932.

DeKruif, Paul. *Men Against Death*, Harcourt Brace, N. Y., 1932.

Dietz, David. *Medical Magic*, Dodd, Meade and Company, 1938.

Haggard, H. W. *The Lame, the Halt and the Blind*, Harper, N. Y., 1932.

Haggard, H. W. *Devils, Drugs and Doctors*. Blue Ribbon Books, Inc., N. Y., 1933.

books and pamphlets⁵ furnish much interesting related material.

With this background the class is ready and eager to take up a more intensive study of the nature of microscopic organisms and specific diseases caused by them. This may start with a study of the various types of parasitic organisms which cause disease, such as bacteria, molds, filterable viruses, protozoa and the higher animal parasites, or preferably it may go immediately into the study of the nature of all bacteria, what they are like, what conditions favor their growth, what conditions limit their growth, how they are spread and how they can be exterminated.

Some simple laboratory experiments which can be done in this connection are:

Meyer, Ben. *Your Germs and Mine*, Doubleday Doran. Garden City, New York, 1934.

Wells, H. G., Huxley, Julian, Wells, G. P. *The Science of Life*, Book Seven, Health and Disease, Doubleday Doran, Garden City, N. Y., 1934.

Health Through the Ages, Metropolitan Life Insurance Company.

Health Hero Series including, *Pasteur, Koch, Jenner, Trudeau, Nightingale, and Reed*. Metropolitan Life Insurance Company.

(1) Prepare nutrient agar culture plates and grow bacteria from various sources such as the dust in the air, dust from window sill, tap water, aquarium water, river water, dishwater, imprint of soiled and clean hands, soil, clean glassware at neighborhood soda fountain, water fountains, sneezes, and coughs; (2) Make a count of bacteria in a cubic centimeter of water; (3) make a count of bacteria in a cubic centimeter of milk by dilution method; (4) Grow a mold garden and make a microscopic study of spores and growth; (5) Test the effect of a lack of food on the growth of yeasts; (6) Test the effect of different temperatures on growth of yeast; (7) Test the effect of drying on growth of mold and bacteria; (8) Test the effect of sunlight on bacteria; (9) Test the effect of antiseptics and disinfectants on bacteria; and (10) Make a microscopic study of yeasts noting reproduction by budding.

Recent magazine articles treat many of these specific diseases which the class will wish to study. These descriptions may be supplemented by book descriptions and various pamphlets.⁶ Much interest should center around the study of those diseases which are now causing the greatest havoc in our cities and also around those diseases which have been conquered through the applications of science. It is through these successes that one gets an understanding of the nature of the scientific controls now in use.

One cannot study specific diseases adequately without getting into the problem of how the body protects itself against these diseases. First, we have to consider how the body tends to prevent the entrance of these disease organisms and the specialized and devious routes by which some organisms enter. Once germs are in the body we need to consider the work of the phagocytes together with the natural pro-

⁶ *Bacteria*. Metropolitan Life Insurance Company pamphlet.

Many other pamphlets on specific diseases are furnished by the Metropolitan Life Insurance Company.

fective immunities which combat germs. This ties up directly with the use of toxins, vaccines and inoculations which develop an active immunity against specific organisms, and the use of antitoxins and serums in the treatment of disease.

Some laboratory experiments of interest in this connection are: (1) To develop haemolytic serum in rabbit blood to red corpuscles of rat or guinea pig, by repeated injections; (2) Vaccinate a rabbit with smallpox vaccine virus and later show that the rabbit has developed antibodies and will not take a second time; (3) Demonstrate hypersensitiveness by intravenous injection of guinea pig with horse serum, or purified proteins such as egg albumen, or casein of milk; (4) Show effect of diphtheria antitoxin in safeguarding a guinea pig from diphtheria toxin; (5) Have school doctor conduct tests for immunity to various diseases on members of the class, followed with vaccination or inoculation in susceptible cases; and (6) Make blood smears and observe the white blood corpuscles through the microscope. Visits to the laboratory of some hospital, or to a vaccine farm, or to a laboratory where vaccines are prepared should prove interesting.

How do we prevent the spread of these serious maladies? Sanitary measures have much to do with their control and can be studied at this time. Respiratory diseases are spread largely by discharges from the mouth and nose. Diseases of the digestive tract can be spread through water or food that comes in contact with fecal material. Some are spread by direct contact or by mechanical carriers such as the house fly, cockroach and rat. Others require necessary carriers such as the mosquito in the cases of malaria and yellow fever, and so on. One cannot avoid touching the work of the water and sanitary departments of the city. The methods of purifying water are familiar to those who have general science but much of the laboratory work connected with them is new and could be treated effectively. The various methods

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of sewage disposal should prove of especial interest. Those methods which depend upon living things for the disposal of waste serve as excellent illustrations of the biologic removal of material dangerous to man.

Some laboratory experiences somewhat related to the prevention of the spread of diseases are: (1) Culture house flies in the laboratory and study their life cycle, then examine under low magnification noting the hairs on the legs, then let one walk across a sterile culture plate and observe, after incubation, how effective a dispenser of germs the creature really is; (2) Examine pond water for mosquito larvae; study them on the microscope; finally demonstrate the effect of oil upon their welfare; (3) Examine prepared slides such as those used by the health department in diagnosing specific diseases—useful ones are; Negri bodies, agglutinated and non-agglutinated typhoid bacilli, stained tuberculosis bacilli, gonorrhea bacteria, syphilis germs, pneumonia bacteria, and malaria-infected red blood corpuscles; (4) Study lantern slides such as: tapeworm, trichina

worm, liver flukes, life history of house fly, life history of mosquito, body lice, various bacterial types; (5) Collect polluted water or shellfish from polluted water and test water from them for total bacterial count, and for bacilli coli as indicative of fecal pollution using either brilliant green bile medium, or lactose broth and Endo's medium.

Useful trips in this connection may be taken to a modern dairy to study methods used to safeguard milk, to a creamery to observe methods used to safeguard milk as well as specific laboratory techniques, to the water department laboratory where the water samples are tested, to the city incinerator, to the sewage disposal plant, and to public health exhibits in local museums.

Finally the full impact of this work may be brought right back to the community by consideration of ways of improving the health in the local community. This may be done by studying the contrast in living conditions in the local slums and the more healthful sections. Such a study might easily start a community betterment program.

Digests of Unpublished Investigations

AN ANALYTICAL STUDY OF ATTAINMENT OF SPECIFIC LEARNING PRODUCTS IN ELEMENTARY SCIENCE

WILBUR LEE BEAUCHAMP*

UNIT I

Problem.—To determine the extent and nature of the individual differences which arise in attaining specific learning products in elementary science.

Method.—This investigation was conducted with 21 unselected pupils in a sub-Freshman class in the University of Chicago High School. At the beginning of the experiment a battery of tests was given which included the Stanford Revision of the Binet-Simon Test; the Thorndike-McCall Reading test; the Van Wagenen Reading Scale in Science; a pre-test of the Best-answer type, constructed by the investigator to measure experiential background; 8 records of 20 minutes each for every pupil, with the Chicago Sustained Application Profile. The results of these tests showed that the pupils were superior both in intelligence and in rate and comprehension of reading; that before the experimental work was begun there were wide individual differences in the experiential backgrounds not only of the various pupils in any given unit but also of a given pupil in the different units; and that there were "marked individual differences and variations in the percentage and quality of application."

The investigation was carried on during 4 fifty-minute periods per week from October 1st to May 15th. During this time four units were studied, "The Earth on Which We Live," "Weather and Climate," "Food," and "Our Water Supply." The

* Unpublished dissertation for the Degree of Doctor of Philosophy, University of Chicago, 1930.

materials of instruction for these units were secured from textbooks, reference books, field trips, experiments, oral presentations by the teacher, lantern slides, drawings, newspapers, and government bulletins.

The class was taught by its regular teacher, though the investigator was present at every class meeting. The teaching procedure followed the five steps outlined by Morrison,¹ namely, Exploration, Presentation, Assimilation, Organization, and Recitation. Problems, subdivided into a series of exercises, were set for the pupils to solve individually during the assimilation period. The investigation was chiefly concerned with the "differences in time and the number of trials required to attain the prescribed learning products," though other aspects of individual differences were also studied.

In order to establish a control of the time factor, the pupils were required to do all their work during the class period; no homework was assigned. The pupils were told to read through each problem and then to perform the exercises prescribed for it. They worked under the direct supervision of the instructor and the investigator who took special care to insure that the pupils did not receive help. Observation was made of the habits and methods employed by the pupils in meeting the situations presented to them.

Each pupil worked at his own rate

¹ Henry C. Morrison, *The Practice of Teaching in the Secondary School*. Chicago: University of Chicago Press, 1926, Chapter XI.

through the assimilation period. Such additional work as he might do after completing the required problems of the exercise, and while awaiting the completion of time assigned to that unit, was not considered in this experiment. All papers were collected at the end of each period and were returned to the pupils during the next class period. Absences were taken into account in the various units in which they occurred.

Each solution was checked for correctness against a solution of the problem by the investigator, and if incorrect, was returned to the pupil for correction. "No differentiation for degrees of understanding was made; credit for a solution was given only when a problem was satisfactorily solved." Thus the "number of trials or attempts necessary to attain the specific understanding" was determined. A record was kept, also, of the day on which each exercise in each problem was completed, and of the total time required to complete each exercise. These data permitted the determination of individual differences and variations in the rate of work.

The written reports of the solutions were analyzed for characteristic errors and for the nature of the difficulties encountered.

Findings.—1. As the pupils progressed through the units individual differences were found to develop with respect to attitudes toward work and methods of study; the time required to attain the specific learning products; the number of trials required to solve the exercises; the interpretation of the exercises presented for solutions; the types of errors made and the causes of these errors; and the ability to perform the different activities required in the study of science.

UNIT II

Problem.—To determine the factors which influence the progress of pupils in the attainment of specific learning products.

Method.—A comparison was made of the records of the experimental class (A) with those of a class (B), which the investi-

gator had himself taught the preceding year by the same method and with practically identical units. Especial attention was paid to the time required for the completion of the same units by these two classes under different instructors who used somewhat different teaching techniques.

An analysis of the causes for slow or unsatisfactory pupil work in class A led the investigator to alter his method of instruction (1) by carefully formulating the ideas to be attained by the pupils in the unit; (2) by constructing a series of exercises directly focused upon these ideas; and (3) by setting up definite standards for the work of each period. He then compared the results secured by the original method used with Class A, with those obtained with a class (C) in which the new methods were employed. He also compared the number of attempts required in completing various units by Classes A, B, and C.

Findings.—1. "The teacher has little if any effect upon the total time and number of attempts, or upon the extent of the individual differences and individual variations in completing the exercises."

2. "The technique of instruction exerts a greater influence upon the total time required to complete the exercises than do the individual differences in the pupils themselves."

3. "The technique of instruction influences to a small degree the variability in the amount of time required to complete the unit."

4. "The technique of instruction has little if any effect upon the individual variations in the time required for completing the exercises of the different units."

5. "The technique of instruction exerts a slight influence upon the total number of attempts required."

6. "The technique of instruction has little if any effect upon the individual differences and variations in the number of attempts required to solve the exercises."

UNIT III

Problem.—To determine the effect of instruction upon learning to make comparisons.

Method.—Two classes were used in this unit. One class, the control group, was given no instructions; the other, the experimental group, was given specific instructions on two separate occasions, the first time by means of detailed mimeographed directions of the steps to be followed; and the second time by means of individual conferences of the teacher with the pupils as the latter worked at making comparisons. The same test was subsequently administered to both groups.

Findings.—1. Instruction in how to make comparisons "results in a method of response which is different from that obtained when no instruction is given."

2. Instruction in how to make comparisons "increases the ability of the pupil to find likenesses and differences in the data given."

General Conclusions.—1. "... while progress in the study of science is definitely related to such factors as intelligence, ability to read, experiential background, and sustained application, there are so many exceptions to this general relationship that the results are of little value in interpreting individual progress unless accompanied by observations of the pupil's method of work."

2. "... the learning situation is extremely complex. ... There is a constant shifting of attitudes and methods of work and ... each exercise is qualitatively different for each pupil in the class. The

interaction of these variable factors with other variables results in a change in the total situation which again reacts to influence the behavior of the pupil in a given situation. The result is a learning situation that is in a state of constant flux. It is thus practically impossible to isolate one factor and definitely determine its causal effect."

3. "... there are many kinds of activities employed in the study of science and ... the ability to carry on these activities is specific rather than general."

4. Most of "the individual variations which cause slow progress are corrective in nature. This is particularly true of application, attitudes toward study, and methods of study."

5. "... individual differences and variations in the pupil are more closely related to progress than is the method of instruction employed."

6. "... direct instruction in a method of study results in an increase in the ability to do that type of study."

7. "Pupils need to be made conscious of the types of study employed in science. ... Pupils need to be taught how to solve the various kinds of problems, how to observe demonstrations, how to make analytical drawings, etc."

8. "... pupils need to be made conscious of their abilities and limitations."

9. "... the study of science must inculcate the methods of thinking employed by the scientist in the solution of problems. Subject-matter alone will not produce the desired learning products. The crucial point in the teaching of science is the method employed by the teacher."

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Editorials and Educational News

WHAT IS THE MATTER WITH THE TEACHING OF SCIENCE?

"On a wide frontier that extends from the interior of the atom to the farthest reaches of astronomical space, science forged forward during 1937. Some of the discoveries in the world's thousands of laboratories will bear fruit only in years to come. Others will be more speedily transformed into new industries, new courses for human ills, new gadgets for easier, better and more intelligent living."¹

Opportunities for teachers of science are not lacking. Yet the recognized importance of teaching science is in strange contrast with the complacency and the laissez faire attitude of many engaged in the service. There are teachers whose devotion and results obtained are extraordinary, but the number of such is still far too small.

What is the matter with the teaching of science?

Science and the investigators in the field are far in advance of the masses of mankind. Glenn Frank has this to say, "The future of America is in the hands of two men—the investigator and the interpreter. We shall never lack for the administrator, the third man needed to complete the trinity of social service. And we have an ample supply of investigators, but there is a shortage of readable and responsible interpreters, men who can effectively play mediator between specialists and laymen. . . . A dozen fields of thought are to-day congested with knowledge that the physical and social sciences have unearthed, and the whole tone and tempo of American life can be lifted by putting this knowledge into general circulation. But where are the interpreters with the training and will-

ingness to think their way through this knowledge and translate it into the language of the street? I raise the recruiting trumpet for the interpreters."

The teacher, the interpreter, needs more than mere information. A new point of view, a new way of thinking, is needed. The result should be a new type of public mind submissive to the discipline of scientific methods of thinking and living. Mediocre teachers of science, interested primarily in information, should give way to such as are alive to the possibilities of "science as a way of life." For inspiration let teachers visit such laboratories as exist at Nela Park, Cleveland; Mellon Institute of Industrial Research, Pittsburgh, and many others.

What is the matter with the teaching of science?

Should propagandists continue to fool millions of men, women and children for the purpose of gathering in shekels to enrich those who are unwilling to deal honestly? Why does the demagogue succeed in his emotional appeal, primarily for his own aggrandizement and prestige, indifferent to human welfare? Shall fakers and quacks and pseudo-scientists forever make countless thousands mourn while science offers "easier, better and more intelligent living"? For suggestions to teachers to serve as guides in analyzing propaganda let them read: "Propaganda Analysis May Protect You Against It,"² "Can We Be Socially Intelligent?"³ and "Institute for Propaganda Analysis."⁴

Why do superstitions haunt homo sapiens? Teachers cannot laugh off this idea.

² *Science News Letter*, Dec. 25, 1937, Vol. 32, No. 872, p. 410.

³ *Scientific Monthly*, Dec., 1937, Vol. XLV, No. 6, p. 555.

⁴ *SCIENCE EDUCATION*, Dec., 1937, Vol. 21, No. 5, p. 251.

¹ "Science Progress in 1937," *Science News Letter*, Dec. 25, 1937, Vol. 32, No. 872, p. 403.

Let them ask members of their classes to break mirrors or to eat at a table where thirteen are present. Let them see the motion picture, "Have Times Changed."

Must modern man be plagued with fears of all kinds—fear of poverty; fear of diseases which mean untimely death, or disability worse than death; fear of war; fear of certain social relationships?

Oh yes, anyone can teach science. Shall school executives and administrators continue to assign to the teaching of science such individuals as have no information and no training in the field? Are teachers willing to continue the pretense of teaching science by merely assigning lessons to be recited or by lecturing to classes and letting so-called research dwindle into mere busy work?

"The great scientific revolution is still to come," says John Dewey, "it will ensue when men collectively and cooperatively organize their knowledge to achieve and make secure human values."

George W. Gray, in "The Advancing Front of Science," p. 335, has this to say, "The kingdom cometh not with indifference. It has to be planned for, organized, programmed, integrated. It has to take into account all resources, all needs, all risks, all limitations. The supreme economic lesson of the 1930's is not a demonstration of the inevitability of the business cycle—possibly there is no such inevitability. Nor is it a proof of the folly of trusting paper values, market booms, and other incitements to the gamble. No, *the* lesson is the exposure of the disparity that exists between (1) the richness of knowledge and of skills which we possess, and (2) the paucity of the use which we make of this knowledge and these skills."

Dr. Oscar Riddle should strike a sympathetic chord with all teachers of science, "In our United States I think there is now no more important task for enlightened leadership than that of placing a 4-year program of life science in all our high

schools. Personally, I would rather assist in rendering such a program of study available to our future citizens than make an important scientific discovery."

Beginning with the first years of school life, understanding of natural law and natural phenomena should assume a large proportionate share of the program of studies. Trained teachers may convince young children that natural law cannot be broken, but that millions of humans are breaking themselves against the law. Surely instruction, training, and practice in scientific methods of thinking should help humans to live better individually and to have more genuine concern for the common good. Instruction, training, and practice in the "omnipotent scientific method" should be a paramount concern of all teachers over a period of years. Trained teachers of natural science should begin this work in the elementary school and continue it through the high school. In higher institutions of learning courses in natural science may go the way of Greek and Latin classics if research is the sole objective.

The Educational Policies Commission has made a splendid start in drafting a pattern of progress for American education. Teachers of science might make some suggestions to this Commission, *e.g.*, on this Commission should be an outstanding science man such as Karl T. Compton, Robert A. Millikan, or Edwin G. Conklin. Natural science should occupy a more prominent place in the program of studies on all levels of education. Teachers should be more universally trained to teach both the factual information of science and to cultivate in the entire school population on all levels scientific methods of thinking.

Only by devoted, patient, intelligent, skillful training and practice over a long period of time can be developed en masse desire for truth and the scientific method of thinking. There will be nothing the matter with the teaching of science when

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J. A. HOLLINGER,
Director, Department of Science
and Visualization,
Pittsburgh Public Schools

PROGRAM OF THE ELEVENTH ANNUAL
MEETING OF THE NATIONAL ASSO-
CIATION FOR RESEARCH IN
SCIENCE TEACHING

PHILADELPHIA, PA.
FEBRUARY 25 AND 26, 1938
Headquarters: Hotel Rittenhouse
and
ATLANTIC CITY, N. J.
FEBRUARY 27, 28 AND MARCH 1, 1938
Headquarters: Hotel Madison

Executive Committee

HANOR A. WEBB, President
S. RALPH POWERS, Vice-President
ELLSWORTH S. OBOURN, Secretary-Treasurer
WALTER G. WHITMAN
FRED G. ANIBAL

PHILADELPHIA, PENNSYLVANIA
Friday, February 25, 1938
9 A. M.

*Morning and afternoon:

Morning and afternoon visits to schools or to points of interest, including museums, and industrial plants, assemble Hotel Rittenhouse, Chestnut above 22nd Street. Those wishing to visit only in the afternoon, assemble here at 1:00 P. M. Luncheon in schools or elsewhere.

†Evening:

Dinner Meeting Hotel Rittenhouse, 6:30 P. M.
C. L. Thiele, presiding.

The International Education Association Meeting in Japan, Summer of 1937, with Motion Pictures.

Dr. Reuben T. Shaw, Head of Science Department, Northeast High School, Philadelphia, Pa.

Informal Remarks:

Anna Greve, Bronxville, N. Y.
Hanor A. Webb, George Peabody College for Teachers, Nashville, Tenn.
Walter G. Whitman, State Teachers College, Salem, Mass.

Saturday, February 26, 1938

*9:30 A. M.—Auditorium of the Administration Building, Philadelphia Board of Public Education. Parkway at 21st Street.
Florence A. Doyle, Presiding.

*National Council Elementary Science.

†Joint Session N. C. E. S. and N. A. R. S. T.

Business Meeting and Program:

- I. *Reading Material and the Place of Reading Material in Elementary Science.*
Glenn O. Blough, State College of Education, Greeley, Colo.
- II. *Development of Science Equipment for Classrooms.*
W. W. McSpadden, Teachers College, Columbia University.
- III. *The Cleveland Natural Science Club.*
Ellis C. Persing, Western Reserve University, Cleveland, Ohio.
- IV. *Demonstration Lesson in Elementary Science.*
Joseph R. Lunt, Rhode Island College of Education, Providence, R. I.
(Class to be made up of 25 boys and girls from Philadelphia Schools.)

Luncheon in restaurants near the Administration Building.

12:00 P. M.—Auditorium of Administration Bldg.
John A. Hollinger, Presiding.

Program Meeting:

- I. *Attitudes and Skills Essential to the Scientific Method and Their Treatment in General Science and Elementary Biology Text-books.*
Victor Crowell, State Teachers College, Trenton, N. J.

*National Council Elementary Science.

†Joint Session N. C. E. S. and N. A. R. S. T.

- II. *Pupil Interests in Science.*
Mary Melrose, Cleveland Public Schools, Cleveland, Ohio.
- III. *1002 Childish Questions.*
Hanor A. Webb, George Peabody College for Teachers, Nashville, Tenn.

ATLANTIC CITY, NEW JERSEY

Sunday Evening, February 27, 1938

Dinner Meeting for Members.
Hotel Madison, East Dining Room.
Hanor A. Webb, Presiding.

Dinner.

Presidential Address:

"Apprenticed to Aristotel."

Business Meeting:

Report of the Secretary-Treasurer.
Committee Reports.
Association Business.
Discussion.

Monday, February 28, 1938

9:00 A. M.—Room 9, Atlantic City Auditorium.
Hanor A. Webb, Presiding.

9:00 A. M.—Business Meeting.

Report of Nominating Committee and Election of Officers.
Unfinished Business.

- 9:30 A. M.—*Report of Committee of Five.*
Ralph K. Watkins, *Chairman.*
- 10:30 A. M.—*Panel Discussion.*
Techniques for Developing Problem Solving Abilities in Science Teaching.
Chairman, William Clark Trow,
School of Education, University
of Michigan, Ann Arbor, Mich.
- Panel:*
Fred P. Frutchey, Ohio State University, Columbus, Ohio.
Frank C. Jean, State College of Education, Greeley, Colo.
Victor H. Noll, Rhode Island State College, Kingston, R. I.
Ellsworth S. Obourn, John Burroughs School, Clayton, Mo.
Charles J. Pieper, School of Education, New York University, New York, N. Y.
Ralph W. Tyler, Ohio State University, Columbus, Ohio.
George C. Wood, James Monroe High School, New York, N. Y.
- Discussion.*

Tuesday, March 1, 1938

Joint meeting with the American Educational Research Association.

- 9:00 A. M.—*Room 9, Atlantic City Auditorium.*
D. H. Sutton and Hanor A. Webb,
Presiding.
- 9:00 A. M.—*A Study of the Standards or Factors or Criteria Determining the Selection of Secondary-School-Science Teaching Materials.*
Cyrus W. Barnes, School of Education, New York University, New York, N. Y.
- 9:30 A. M.—*Important Abilities and Knowledges for Teachers of Secondary School Physical Science in the Use of Apparatus, Materials and Tools.*
G. P. Cahoon, School of Education, Ohio State University, Columbus, Ohio.
- 10:00 A. M.—*A Technique for Appraising Certain Observable Behavior of Children in Science in Elementary Schools.*
Joe Young West, State Teachers College, Towson, Maryland.
- 10:30 A. M.—*An Attempt to Measure the Amount of Growth in Scientific Attitudes.*
Ralph C. Bedell, State Teachers College, Warrensburg, Missouri.
- 11:00 A. M.—*A Review of Educational Research in Science.*
S. Ralph Powers, Teachers College, Columbia University, New York, N. Y.
- 11:30 A. M.—*Summary and Discussion.*
- 12:30 P. M.—*Luncheon and Business Meeting for the Executive Committee.*
Hotel Madison.

REPORT OF THE FIFTH ANNUAL MEETING OF THE AMERICAN SCIENCE TEACHERS ASSOCIATION

"ASSOCIATED WITH THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE," INDIANAPOLIS, DECEMBER 29-30, 1937

With this meeting the organization of the American Science Teachers Association, initiated in Boston, December, 1933, was completed. The Board of Directors representing the members at large and the thirteen charter affiliated organizations of science teachers held a dinner meeting and conference Wednesday evening, December 29. These representatives and others elected at previous meetings were from seven different states. The public meeting of the Association held on Thursday, December 29, was attended by approximately 250 teachers from 25 states and 70 cities. These data are mentioned to indicate the country-wide interest in the American Science Teachers Association.

At the directors' meeting, representatives of the different organizations made brief reports disclosing among other things that the affiliated membership now totals upward of 3000 members. Moreover, the affiliated organizations represent many of the strongest and largest science teachers' associations in the country. Applications have been received for affiliation from other organizations, and it is expected that these will increase considerably during the coming year. Every science teachers' organization in the country is invited to write for information regarding affiliation.

The Board of Directors gave careful attention to the need of a national science teachers' journal. A committee under the chairmanship of Mr. Walter G. Whitman, of the State Teachers College at Salem, Massachusetts, reported recommendations. Discussion of the problem at Indianapolis indicated the need of a national journal of science education covering the field of a twelve-year science program. It was felt that such a journal must give greater

help to teachers in service than is now done by any single journal. It must keep them in touch with educational problems in science, provide them with information of the latest developments in science itself, let them know what other science teachers are doing, and offer an abundance of science teaching and technique aids. A long list of specific ways in which such a journal could meet the needs of science teachers was reported.

It was suggested further than in the interest of efficiency and economy, it would be well if a number of existing science journals would agree to a union of effort. A Publications Committee which was re-appointed by the Board of Directors will try to discover upon what terms those willing to cooperate will join such a union. Some of these publications are owned by science associations. If a union can be made, it is only reasonable that these associations shall have fair representation on the new journal. In fact, each affiliated organization of the A. S. T. A. should have representation on the journal staff or on the Publication Board of Control.

It was also brought out that enrolment in science in high schools appears to be decreasing. Laboratory instruction is decreasing, and there is a felt need of devising ways and means of bringing more forcibly to the attention of principals and superintendents than at present the important place that science education has and must continue to have in American education.

The Board of Directors have directed the Publications Committee to canvass the field and work out some plan looking forward to the possibility of a journal of science education that will more adequately meet the needs and interests of a large number of science teachers than is now available and report back to the Board of Directors within the year. Correspondence with the Chairman, Mr. Whitman, is solicited by any and all interested in such a project.

The program held Thursday forenoon and presided over by Dr. Earl R. Glenn, State Teachers College, Montclair, New Jersey, was an outstanding event in the history of all science teachers' meetings. Two of the speakers were Nobel Prize winners. The third speaker was a year ago awarded the \$1,000 prize for research relating to the cause of the tobacco mosaic disease.

The symposium topic under discussion, *New Knowledge of Matter*, was developed under the following titles:

Properties of the Isotopes of Oxygen, Dr. Harold C. Urey, Columbia University.
Some Physical and Biological Consequences of the Discovery of X-rays, Dr. Arthur H. Compton, University of Chicago.
Recent Discoveries Concerning the Virus Diseases, Dr. W. M. Stanley, Rockefeller Institute for Medical Research, Princeton, N. J.

It is not the purpose of this report to digest these important papers. It is expected that they will be published in an early issue of the *Scientific Monthly*. One important activity of this meeting was the broadcasting of the first fifteen minutes of Dr. Compton's talk over the Mutual Broadcasting System. This broadcast served as the Christmas Lecture for the children's clubs of the American Institute of the City of New York and for like groups of children all over the country. It is hoped that this Christmas Lecture may become a permanent feature of the American Science Teachers Association annual meeting.

The luncheon meeting presided over by Dr. Otis W. Caldwell, General Secretary for the American Association for the Advancement of Science, was addressed by Dr. George D. Birkhoff, President of the American Association for the Advancement of Science. His topic was *Present Status of Aesthetic Measure*. It was a rare treat for the science teachers to listen to a mathematician of note bringing aesthetic things into the realm of measurement.

The afternoon session, Thursday, December 30, was presided over by Harry A.

Carpenter, Specialist in Science, Rochester Schools, Rochester, New York. The symposium topic discussed was *The Need for a Twelve-year Science Program for American Public Schools*. Dr. Ralph K. Watkins, University of Missouri, discussed the topic *From the Viewpoint of a State University and Its Laboratory Schools*. Miss Mary Melrose, Supervisor of Elementary Science in the Cleveland Public Schools, Cleveland, Ohio, presented *The Viewpoint of Experimental Schools in City Systems*. Dr. W. C. Croxton, State Teachers College, St. Cloud, Minn., gave us *The Viewpoint of Colleges That Train Teachers for Rural Schools, Villages and Towns*. Mr. George L. Bush, South Side High School, Cleveland, Ohio, discussed the topic *From the Viewpoint of High Schools Enrolling Many Students Who Do Not Expect to Attend Colleges*.

Dr. Otis W. Caldwell, Yonkers, N. Y.; Dr. Morris Meister, Supervisor of Junior High Schools of New York City, and Miss Edith R. Force, Wilson, Jr., High School, Tulsa, Okla., presented opinions relating to the topic *From the Viewpoint of the Inter-Relationships of National, State, and Local Science Organizations*.

It is expected that these papers will be published in an early issue of SCIENCE EDUCATION.

It seems evident that science teachers everywhere are discovering the growing need for a twelve-year science program, and one of the objectives of the American Science Teachers Association will be to promote this objective through a special working committee.

Following the afternoon meeting, the teachers' assembly elected their representatives on the Board of Directors as follows:

Dr. Harry A. Cunningham, Kent State University, Kent, Ohio, one year.
Dr. Ralph K. Watkins, University of Missouri, Columbia, Mo., two years.
Miss Ada L. Weckel, Oak Park High School, Oak Park, Ill., three years.

At a second meeting of the Board of Directors the following officers were

elected and committee chairmen appointed for the ensuing year:

President—Harry A. Carpenter, Specialist in Science, Rochester Public Schools, Rochester, N. Y.

First Vice-President—Mr. W. L. Eikenberry, State Teachers College, Trenton, N. J.

Second Vice-President—Dr. James E. Brock, Wayne State Teachers College, Wayne, Neb.

Secretary—Dr. Harry A. Cunningham, Kent State University, Kent, O.

Treasurer—Mr. Homer W. LeSourd, Milton Academy, Milton, Mass.

The following members of the A. S. T. A. were elected as Directors-at-Large:

Dr. W. J. Klopp, Supervisor of Secondary Education, Long Beach, Cal., 1 year.

Dr. Earl R. Glenn, Montclair State Teachers College, Montclair, N. J., 2 years.

Mr. W. L. Eikenberry, State Teachers College, Trenton, N. J., 3 years.

Dr. Otis W. Caldwell, General Secretary, A. A. A. S., 4 years.

The constitution calls for election of three members of the Board of Directors to serve with the officers as an Executive Committee. The Chairman was directed to appoint these members and accordingly, the following have been appointed:

Dr. Don O. Baird, State Science Teachers Association, Texas.

Dr. Morris Meister, The Physics Club of New York.

Mr. Wilhelm Segerblom, New England Association of Chemistry Teachers.

Chairmen of committees designated are as follows:

To cooperate with the Department of Science Instruction of the N. E. A.—Mr. Wilhelm Segerblom, Phillips Exeter Academy, Exeter, N. H.

Journal Committee—Mr. Walter G. Whitman, State Teachers Association, Salem, Mass.

Extra Curricular Activities Committee—Dr. Morris Meister, Haaren High School, New York City.

The next annual meeting of the Association will be held at Richmond, Virginia. It is hoped that many science teachers will begin planning now to attend that meeting. Preliminary program announcements will be found in early issues of science teachers' journals.

HARRY A. CARPENTER, *President*

HARRY A. CUNNINGHAM, *Secretary*

Abstracts

GENERAL EDUCATION

CALDWELL, OTIS W. "Some Considerations Regarding Science and Education." *School Science and Mathematics* 37: 840-843; October, 1937.

The author develops his discussion under three points: the expectations which we hold for the educational uses of science; the intellectual aspects of science; and science education and the growth of science knowledge. He summarizes his presentation thus: "The expectations which we hold for the uses of science in education are that science shall produce better results in the lives of people, and increase in the number of those who benefit through science education, and added growth in worth while science knowledge." "The intellectual aspects of science education, which formerly were dominant, must not be lost in our present-day objectives." "If science is most usefully taught, its way of working continues from childhood to adult life, and results in constant additions to science knowledge." —F.D.C.

BRUNER, HERBERT B. "Criteria for Evaluating Course-of-Study Materials." *Teachers College Record* 39: 107-120; November, 1937.

In 1937 there were 30,000 separate subject courses of study and 10,000 general courses which had been received by the Curriculum Laboratory of Teachers College. Criteria used by the Curriculum Laboratory in evaluating courses of study were as follows:

1. *Philosophy*: (a) Social philosophy; (b) Educational philosophy; (c) Principles of learning.
2. *Content*: (a) Authenticity; (b) Utility; (c) Adequacy and significance; (d) Organization.
3. *Activities*: (a) Pupil purposing; (b) Interest and needs; (c) Social values; (d) Reality; (e) Variety; (f) Approach; (g) Culminating activity.
4. *Evaluation of pupil's work*: (a) Purposes; (b) Variety; (c) Validity; (d) Areas of growth; (e) Interpretation.

Interpretative statements are included under each of the above criteria. Of 1750 science courses of study received, 20.2 per cent, or 353, were judged outstanding. This per cent is second highest, being exceeded only by the social studies. —C.M.P.

THORNDIKE, EDWARD L. "What We Spend Our Money for." *Scientific Monthly* 45: 226-232; September, 1937.

Using as observers eight psychologists, five home economic experts, three economists and a small miscellaneous group, the writer attempted to find out what we spend our money for and why. Six items were intensely studied: food, clothing, rent, life insurance, laundry, death and burial. Each of

these six items were considered from twenty-four possible wants or reasons for expenditures: (1) Hunger; (2) Protection against cold, heat, and wet; (3) Exercise; (4) Sleep, rest; (5) Sex relief; (6) Reproduce species; (7) Protection against animals and disease; (8) Protection against bad people; (9) Reduce or avoid pain; (10) Pleasures of taste and smell; (11) Pleasures of sight and sound; (12) Sex entertainment; (13) Security; (14) Affection; (15) Companionship; (16) Approval of others; (17) Approval of one's self; (18) Mastery over others; (19) The welfare of others; (20) Mental activity; (21) Curiosity and exploration; (22) Social entertainment; (23) Physical entertainment; and (24) Comfort.

The sixteen hours of the working day of adults in the United States are spent roughly as follows: for subsistence and perpetuation, 25%; to avoid or reduce sensory pain, 2%; for security, 7%; for welfare of others, 8%; for entertainment, 30%; for companionship and affection, 10%; for approval, 10%; for intellectual activity, 4%; for dominance over others, 2%; for other wants, 2%. —C.M.P.

ANONYMOUS. "At the League of Nations." *Journal of Calendar Reform* 7: 129-134; October, 1937.

This is the official report of the Council Proceedings of the League of Nations meeting at Geneva, September 4, 1937. On the agenda was the question of the reform of the calendar and the final decision was that the present condition of world affairs made it an inopportune time to introduce a new calendar. Thirty-two governments made replies of which ten favored the World Calendar. The United States was non-committal.

—C.M.P.

RUSSELL, WILLIAM F. "Report of the Dean of Teachers College for the Year Ending June 30, 1937." 122 p. November, 1937.

This is the annual report made to the Trustees of Teachers College. As Dean Russell phrases it, "At Teachers College we have 'prance horses of pedagogy' and 'work horses' as well. We have theorists on our faculty—radical, conservative and all shades in between; and the professors with divergent views often appear before the same class within the same period. Several 'prance horses' can run on the same educational tract at the same time, trotters, pacers, hunters, racers, even circus horses—all in one big unhappy family. (Abstractor's note: Dean Russell forgot to mention his old nags!) The contrasting, sharply divergent tech-

niques, philosophies and curricula found in the Horace Mann School for Boys and the Lincoln School make this report an unusual tidbit.

—C.M.P.

SCHOEN, MAX. "Can We Be Socially Intelligent?" *Scientific Monthly* 45: 555-565; December, 1937.

Owen D. Young is reported to have said society today is in the position of Columbus who, when he started out, did not know where he was going, when he got there did not know where he was, and when he returned did not know where he had been. Why have we managed our affairs so unintelligently? The answer is because the propagandist, whether politician, priest, pedagogue or professional reformer is shrewd in his tactics. His shrewdness is threefold: (1) He masks his greed for power and pelf in a cloak of altruism. He never speaks in his own name, but in the name of God or man; (2) He offers easy and quick ways to salvation. All we need to do is follow his panaceas and we shall reap a rich harvest. He

boasts of being practical; (3) He has a set of well-established alibis that absolve him from the responsibility for the evils created by his operations. Social diseases are like physical diseases. They do not merely happen, they are caused. We can be socially intelligent if we deliberately and conscientiously set out to be so.

—C.M.P.

DUNNING, J. R., AND FARWELL, H. W. "The Two Year Science Program in Columbia College." *The American Physics Teacher* 5: 150-156; August, 1937.

A new science program consisting of a two-year integrated sequence in the physical and biological sciences has been in operation in Columbia College since 1934. Results obtained have been most satisfactory and encouraging. Teaching aids and devices include a science reading room, laboratory work, special field trips, class meetings, discussion groups and weekly quizzes. The course is a two year course, each semester of which has a specialist in charge.

—C.M.P.

ELEMENTARY SCIENCE

PALMER, E. LAWRECE. "Teachers Number." *Cornell Rural School Leaflet* 31: 3-64; September, 1937.

This number of leaflet provides supplementary material for use with the New York State outline of elementary science. The contents include: (1) The sun and its family; (2) Time chart of the planets; (3) Synoptic time chart; (4) How to make a planisphere; (5) Earth history; (6) Records of fossil mammals; (7) Books useful in science, nature study and conservation education; and, (8) Summary of leaflets.

—C.M.P.

PALMER, E. LAWRENCE. "Are They Vermin?" *Cornell Rural School Leaflet* 31: 3-32; November, 1937.

Many animals that are considered by farmers and others as detrimental are definitely helpful

and should be fully protected. This leaflet is an excellent source of information regarding so-called predatory animals and is recommended reading for all teachers, farmers, and others interested in animal and crop preservation. A practical chart on animals includes the following information: (1) Description; (2) Where found; (3) Range; (4) Relations and history; (5) Behavior; (6) Reaction to heat, light and moisture; and, (7) Relation to man's interest.

—C.M.P.

HANSEN, VIOLET. "Sky Study." *The Grade Teacher* 55: 12-13; 64-65; January, 1938.

This is an illustrated unit on astronomy. The subject matter includes a study of the sun, moon, stars, constellations and planets. Several myths about the constellations are included. Illustrated.

—C.M.P.

SECONDARY SCIENCE

LATON, ANITA D. "Planning a Unit in Biological Science." *University High School Journal* 16: 1-9; October, 1937.

The writer discusses types of organizing centers for biology units and several possible approaches for introducing the unit. Give as much sensory experience as possible. Keep important ideas in mind and choose activities to teach these. Help should be given to students to enable them to see the significance of what they are learning for human thought and action. A variety of activities should be planned to care for individual differences in interest and background. A functional testing and evaluation program should be developed.

—C.M.P.

SIMMONS, MAITLAND P. "Changing Conceptions of Major Topics in General Science Textbooks (1911-1934)." *Journal of Educational Research* 31: 199-204; November, 1937.

Eighteen general science textbooks are compared. The subject matter content is grouped under sixteen topics. As a whole the per cent of space devoted to each topic has not changed materially except in the case of health, more than twice as much space being devoted to that topic now as compared to 1911-16. About twice as much space is devoted to health as to any other topic.

—C.M.P.

DUEL, HENRY W. "Measurable Outcomes of Laboratory Work in Science: A Review of Experimental Investigations." *School Science and Mathematics* 37: 795-810; October, 1937.

The first part of this discussion is concerned with a critical summary and review of nearly forty research investigations and discussions of the relative merits of the individual and the demonstration methods of conducting laboratory work. The final part of the article presents a brief summary of the

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author's dissertation, in which a study was made of two classes of college students in a course of mechanics, one group having two hours of laboratory work per week and the other no laboratory work. The class with no laboratory work was found to achieve as well as did the class with two laboratory periods per week, with respect to acquiring knowledge and understanding of fundamentals of mechanics, development of scientific aptitudes, and acquisition of manipulative skills and of knowledge of laboratory techniques.

LEVELLE, J. M. "An Experiment in the Teaching of High School Chemistry." *School Science and Mathematics* 37: 946-952; November, 1937.

This experiment began with the introduction of voluntary laboratory work in chemistry for which no credit was given. Seventy-one per cent of the pupils together spent more than seven hundred periods in the laboratory during twenty-two weeks under this plan. On the basis of these results the author suggests a new chemistry schedule under which, during the first semester, the pupils will study chemistry for three lecture periods and two double-laboratory periods; and during the second semester these pupils will be divided into two sections, the superior students continuing the regular schedule of seven periods per week, in groups as small as 14 pupils each, while the mediocre and poor pupils will be taught five periods by lecture-demonstration, in large sections. —F.D.C.

HARLEY, HENRY P. "How to Keep Forty Busy." *School Science and Mathematics* 37: 982-986; November, 1937.

This article explains in detail a plan by which at the beginning of the period "thought-inspiring questions or activity assignments are written on the blackboard or projected on a screen." The pupils then engage in writing in their notebooks the answers to these questions, or in performing the individual activities while the teacher goes about the room giving individual assistance. After this work has progressed for fifteen or twenty minutes, class discussions of the assignments follow. In the latter part of the article, a plan for developing leadership is described in connection with an elaborate plan for project work. —F.D.C.

PERSING, ELLIS C. "Natural Color Lantern Slides for School and Home." *The Educational Screen* 16: 286-287; November, 1937.

Brief directions are given for using 35 mm. film in color for producing slides in natural color. Estimated cost for preparing such slides in permanent form is about twenty cents per slide. This is considerably less than having colored lantern slides prepared which usually cost one dollar per slide. While, of course, one can make one's own lantern slides at much less cost the amateur is seldom able to do a good job of coloring. Mr. Persing suggests the use of this method for photographing fruits, seeds, insects and other specimens

brought in to class, and for preserving records of charts and other projects prepared by students.

—O.E.Underhill

SPIRES, LOREN C. "The Movie Club as a Visual Educational Project." *The Educational Screen* 16: 285-286, November, 1937.

A brief suggestion as to how a group may be organized to make their own 16 mm. moving pictures in connection with high-school activities. This group at the Community High School, Carterville, Illinois, not only take their own movies but have built the equipment necessary for titling, editing, and developing. The developing is done at a saving of about 75 per cent over commercial prices and a film may be shown a few hours after it has been taken. The club is organized along the lines of a regular motion picture company with selected students from the fields of Art, Mechanics, Physical Science and Typing divided into staffs under Art, Camera, Editing, Dark Room, Technical and Advisory. Films produced concern home geography, local industries, physics films and animated mathematics films. —O. E. Underhill

WALLING, MORTON C. "Hunting Little Big Game with Your Microscope." *Popular Science Monthly* 131: 78-79, 143-146; November, 1937.

Interesting, simple experiments that are possible with the microscope are described. —C.M.P.

WAILES, RAYMOND B. "Spectacular Stunts with Flames." *Popular Science Monthly* 131: 72-73, 135; September, 1937.

This is a series of interesting experiments with flames, excellent for science club work. Burning metals in superheated steam, lighting a cigarette with steam and making your breath "burn" in illuminating gas are among the experiments described. —C.M.P.

WALLING, MORTON C. "Hook a Camera to Your Microscope." *Popular Science Monthly* 132: 94-95, 118-119; January, 1938.

This interesting, illustrated article explains how any science teacher or student may set up a photomicrograph outfit. The cost is low and the pleasures to be derived are great. —C.M.P.

TYRELL, WILLIAM J., AND MCSPADDEN, W. W. "Some Plant Experiments with Inexpensive Materials." *The Teaching Biologist* 7: 27-29; November, 1937.

The following experiments are described: (1) Seeds absorbing moisture swell and exert pressure; (2) Sprouting seeds give off carbon dioxide; (3) The effect of gravity upon root growth may be counteracted by rotating the sprouting seeds; (4) Roots exert force in growing downward; (5) Roots react negatively to an encountered region of dryness; (6) Roots pass through a region of moist air; (7) Roots grow toward a region of moisture from one of dryness; (8) Roots circumnavigate obstacles in the path of their downward growth; (9) Roots secrete acid; (10) The stem of the young seedling exerts pressure upward; and (11) Stems grow toward a source of light. —C.M.P.

SCIENCE

Symposium. "The Chemistry and Physics of Shelter." *Science Leaflet* 10: 6-26; January 21, 1937.

This is an interesting discussion on the ways science is being used in the improvement of the modern home—the development of new building materials and the testing of these under actual conditions of use. —C.M.P.

MACK, WARREN B. "Biology of Resemblance and Difference." *Science Leaflet* 10: 30-34, 26-32; March 18 and March 25, 1937.

In the first of these two articles the author discusses the basis of resemblance and difference and in the second article the transmission of resemblance and difference. —C.M.P.

MACK, WARREN B. "Biology of Distribution." *Science Leaflet* 10: 31-35, 34-39; April 1 and April 15, 1937.

In the first article the author discusses the factors of the physical environment and in the second article the factors of the biological environment. —C.M.P.

WELCH, GEORGE B. "Color." *Science Leaflet* 10: 20-25; March 25, 1937.

This is an interesting discussion of the theory of color and its applications. The author is professor of physics in Northeastern University. —C.M.P.

Symposium. "Copper." *Science Leaflet* 10: 3-21; March 4, 1937.

This splendid illustrated article on copper, its metallurgy, and uses as a pure metal, in alloys and in compounds. —C.M.P.

Symposium. "Iron and Steel." *Science Leaflet* 10: 3-24; April 1, 1937.

This is an excellent article on the metallurgical processes of manufacturing iron and steel. Phases discussed include: location of iron ore fields, kinds of iron ores, pig iron, wrought iron, steel, Bessemer process, open hearth process, ingot blooming mill, sheet bar mill, sheet rolling mill, annealing, galvanizing, and electric steel. —C.M.P.

Symposium. "Spectroscopy." *Science Leaflet* 10: 25-34; April 15, 1937.

These two illustrated articles on spectroscopy are contributed by J. C. Boyce and George R. Harrison of the Physics Department of Massachusetts Institute of Technology. The finger prints of about seventy elements are easily determined by these methods. —C.M.P.

THONE, FRANK. "Without Benefit of Insects." *Science News Letter* 32: 186-188; September 18, 1937.

A world bereft of these small creatures would miss many of man's best friends as well as foes,

says Dr. Edith M. Patch, recently retired head of the department of entomology of the University of Maine. Dr. Patch champions insects not only for the material good they do us, but for the pleasure and mental satisfaction we get from a better knowledge of them. —C.M.P.

DAVISON, LONNELLE. "Platinum in the World's Work." *The National Geographic Magazine* 72: 345-360; September, 1937.

This is an illustrated article describing the sources, metallurgy and uses of platinum, the world's most useful precious metal. —C.M.P.

THONE, FRANK. "Twins May Become Unlike." *Science News Letter* 32: 154-156; September 4, 1937.

Three University of Chicago professors, Horatio H. Newman, Frank N. Freeman, and Karl J. Holzinger have made exhaustive studies of twenty separated identical twins. In general they find that "Human intelligence is not definitely fixed at birth by genetic factors but may be distinctly influenced by such environmental factors as education and social positions. . . . Heredity is dominant in all physical characteristics except the obvious one of body weight. . . . Heredity determines inescapably what you are going to look like, but environment has a great deal to do with the way you think and act." —C.M.P.

HARDING, T. SWANN. "The Persistence of Life." *Scientific American* 157: 92-93; August, 1937.

Stories of bacteria found in meteorites and in early pre-Cambrian rocks of wheat found in early Egyptian tombs that will germinate, and of frogs found alive in walls and early rock formations are all myths. It is true however that the lower the scale of existence, the greater the resistance to lethal agents. —C.M.P.

AARON, S. F. "The Fallacy of Fighting Flies." *Scientific American* 157: 160-161; September, 1937.

The author disagrees with the oft-made assertion that the complete destruction of flies would be a not too difficult matter. He believes that it would be exceedingly difficult, expensive, and that as a practical undertaking may well be discarded. Enemies of flies and methods of controlling flies are discussed. —C.M.P.

TEALE, EDWIN. "Mineral Water Gushers Bring Sudden Wealth in Strange Boom." *Popular Science Monthly* 132: 42-43, 130; January, 1938.

This article describes the bringing of sudden wealth to North Caldwell, New Jersey, because of the accidental discovery of mineral water. Retailing at ten cents a gallon and with an unlimited supply and an unusually great demand, this discovery gives promise of being equivalent to a gold-mine or oil-well discovery. —C.M.P.

Anonymous. "How to Dodge a Cold." *Popular Science Monthly* 131: 34-35; December, 1937.

Some simple rules for avoiding common colds are given. Prominent physicians, hospital directors, and public health officials were interviewed. Illustrated. —C.M.P.

BOONE, ANDREW R. "Snake Hunter Catches Rattlers for Fun." *Popular Science Monthly* 131: 54-55, 146; October, 1937.

This is an interesting illustrated article showing how Captain Donavin Miller captures poisonous snakes. —C.M.P.

SPEISER, E. A. "New Finds at Tepe Gawra." *Scientific American* 157: 133-136; September, 1937.

The most significant archeological excavations ever made on the sites of the ancient early civilizations of Persia and Assyria are now being made at Tepe Gawra, 15 miles north of Nineveh, on the Tigris River. Sixteen superimposed settlements have been excavated. The topmost settlement dated 1500 B.C., the site having been unoccupied since that time. Much valuable, new and interesting information concerning ancient civilizations will result from these excavations. Many of these early peoples had seemingly attained a degree of culture not previously accorded them. —C.M.P.

DAMRAU, FREDERIC. "Medical Miracle Men Cure the Body Through the Mind." *Popular Science Monthly* 131: 42-43, 125-126; September, 1937.

Many of our seemingly physical diseases are those of the mind rather than of the body. By removing the mental quirks that cause physical ills, modern psychiatrists can bring hearing to the deaf, sight to the blind, and relief to the afflicted. —C.M.P.

MALONY, JOHN A. "Radium—Nature's Oddest Child." *Scientific American* 157: 18-20, 83-85, 148-150, 212-215; July, August, September and October, 1937.

This excellent article depicts the absorbing story of radium and its discovery; sources; recovery; strange experiments; its place in medicine; radium water and death; its use in geology; and radium in the bed of the ocean. —C.M.P.

ANTHONY, HAROLD E. "Scientist Describes Visit to Unknown Island in the Sky." *Science News Letter* 32: 245-247, 252-254; October 16, 1937. "The Facts About Shiva." *Natural History* 40: 708-821, 775-776; December, 1937.

These articles describe the Shiva Temple Exploration Expedition made in September on the 275 acre plateau in Grand Canyon, never before visited by white men. The expedition made a scientific study of the fauna and flora of a region which has been isolated from the rest of the world for 20,000 years or more. The final report on the changes that have taken place during this time should prove to be most interesting. A series of

twenty-nine excellent photographs accompany the *Natural History* article. —C.M.P.

ANDREWS, GEORGE B. "Scaling Wotan's Throne." *Natural History* 40: 723-724, 776; December, 1937.

The author describes the exciting feat in which Shiva's sister "sky island" yields to the skilful rock climbers of the Shiva Temple Expedition. Wotan's Throne has an area of about 135 acres and adjoins Shiva's Temple. —C.M.P.

POPENOE, PAUL. "Introverts and Extraverts." *Scientific American* 157: 197-200; October, 1937.

Misunderstandings in business and social life frequently may be traced directly to conflicts between introverts and extraverts. Introverts have their attention turned on themselves; extraverts have their attention turned outward. The former are more concerned with their own thoughts and feelings; the latter, with what is going on around them. Actors, orators, preachers, adventurers, bluffers, squanderers, promoters, and nurses are usually extraverts. Inventors, women teachers, and poets are introverts. —C.M.P.

ROBERTS, H. F. "The Causes of Autumn Coloration." *Scientific American* 45: 427-435; November, 1937.

The yellow colors of autumn leaves are due to carotinoid pigments called xanthophyll and carotin; the red colors are due to anthocyanins. The varying shades between red and yellow result from the varying proportions of carotinoid and anthocyanin present. Frost does not cause the color change, but it is rather due to the cutting off of the leaves from the vital connections with twigs and branches by the formation of a cork layer. —C.M.P.

ANDREWS, ROY CHAPMAN. "Wings Win." *Natural History* 40: 559-564; October, 1937.

Who is the speed champion of the world? Cephonomyia (Deer Fly) says the author. A rate of 400 yards per second or 818 miles an hour has been chalked up against him. There is a most interesting chart showing graphically the speed of animals and insects in the air, on the land, and in the water. The fastest water animal is the flying-fish—35 miles per hour. (Campbell's Bluebird made 129.69 miles per hour.) On land the Cheetah averaged 70 miles per hour for 100 yards—as compared to the automobile's 301 miles. The duck hawk with 180 miles per hour is the second best animal flyer—as compared with the aeroplane's 440.6 miles. —C.M.P.

HUNTER, DARD. "The Story of Paper." *Natural History* 40: 577-597; October, 1937.

This is one of the best articles on the development of paper manufacturing that the abstractor has ever read. Its discovery gave man his passport from savagery to civilization. Bark was first used, long before the invention of paper. Paper was first made in China about the second century. Illustrated. —C.M.P.

THONE, FRANK. "No Two Alike." *Science News Letter* 32: 394-395; December 18, 1937.

This article describes the conditions under which snow crystals are formed. Snow-flakes falling in countless numbers have never produced duplicates in all the winters. Illustrated. —C.M.P.

TISDALE, FREDERICK. "Headache Headquarters." *Scientific American* 158: 22-24; January, 1938.

This article describes the interesting work of the Mellon Institute of Pittsburgh which solves problems and develops new products and processes. It is one of the foremost research laboratories in the world and has more than 700 patents to its credit. —C.M.P.

RUSSELL, HENRY NORRIS. "The Rotation of Our Galaxy." *Scientific American* 157: 336-337; December, 1937.

Recent research based on planetary nebulae provides the most striking evidence and the best picture of galactic rotation thus far made available. Until thirty years ago, upon what looked like good evidence, the solar system was believed to be very near the center of the milky way. Today best estimates indicate that we are 30,000 light years from the center, or about two-thirds of the way out from the center. One revolution of the sun about this center takes 210,000,000 years. The total mass of the galaxy comes out about 230,000,000 times the mass of the sun. —C.M.P.

HUBBLE, EDWIN P. "Our Sample of the Universe." *Scientific Monthly* 45: 481-493; December, 1937.

The observable region of space is a sphere about a billion light years in diameter. This sphere contains about 100 million nebulae each a stellar system comparable with our own Milky Way. There seems to be a homogenous expanding of the universe, and that it appears we now can explore about a quarter of the entire universe. —C.M.P.

CASSELMAN, ELBRIDGE J. "Science Turns to Shaving." *Scientific American* 157: 261-264, 314; November, 1937.

This article is a resume of a five years comprehensive study of shaving technics and devices carried out in the Mellon Institute of Industrial Research in Pittsburgh. The art of shaving is very old, there being barbers in Greece as early as 400 B.C.

Water is actually the great softening agent for hair. No other agent is comparable with it, except those having specific chemical action (and this may extend to the skin itself!). Water penetrates the hair by absorption, reducing its strength and hardness some 60 per cent. Dry hair is harder than lead, aluminum or copper. Lathering with hot water is a better softener than using cold water. A detergent is necessary or advisable to remove oil from the hair before using water to soften it. Shaving results are best if delayed from two to five minutes after applying water to the face. Shaving lotions having an astringent and antiseptic property do no harm and may be helpful. The angle at which the razor is held is very important (this feature is well illustrated). —C.M.P.

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New Publications

HUNTER, GEORGE W., WALTER, HERBERT E., AND HUNTER, GEORGE W., III. *Biology*. New York: American Book Company, 1937. 670 p. \$3.75.

Biology is the result of many years of successful college teaching by two of the authors, plus the less extended but buoyant experience of the younger author. The reviewer will say at the outset that if he were now responsible for teaching a college course in general biology, this is the book he would give a trial in his classes.

The introductory portion deals with the ecological point of view as a means of starting students off in the most effective and stimulating thought about biology. At the close of this section are some fifty pages presenting the classification of plants and animals, with seventeen pages of animal and three pages of plant illustrations to present types of the groups given. Incidentally, this is about the proportion of space given to plants as compared to animals throughout the book, the authors all being zoologists rather than botanists. That the treatment is biological, not specialized science is shown by the division headings: "Fundamentals of Structure and Function," "Organisms Illustrating Biological Principles," "The Maintenance of the Individual," "The Maintenance of the Species," "The Changing World," and "Man as a Conqueror." Because of the disproportionate representation of plant biology, it is possible that some students might gain an erroneous idea of the whole field of biology. Thus, when eleven pages are given to the development of sexuality in plants, thirty-five pages to the role of green plants and several hundreds of pages to related problems in animals, the disproportion is further emphasized. Nevertheless, the treatment of plant biology is excellent in quality, though inadequate in scope. Even so, it is a teachable and effective organization, which will doubtless find a large and welcome use in college classes in biology.

—O.W.C.

KNAPP-FISHER, H. C. *The Modern World: A Pageant of Today*. New York: E. P. Dutton and Company, 1934. 447 p. \$2.50.

This is a remarkably clear and interesting book written especially for boys and girls. It gives a simple, vivid, yet scholarly account of the world from its beginning. It explains what civilization is and tells with fairness and inspiration about various forms of government; the background of their origin and their aims and ideals.

This book should prove a valuable supplement to the study of the social sciences.

—Elwood D. Heiss.

JACOB, HEINRICH EDUARD. *Coffee: The Epic of a Commodity*. New York: The Viking Press, 1935. 296 p. \$3.50.

This work is the biography of an economic product. As one might tell the biography of copper or wheat, in this work is set forth the influence of coffee on man. Its influence upon the outward aspect and internal structure of human society is also discussed.

—Elwood D. Heiss.

SHULL, A. FRANKLIN. *Principles of Animal Biology*. New York: McGraw-Hill Book Company, 1934. 400 p. \$3.50.

This is a college zoology text book. It is one of the few zoology textbooks that is developed strictly around the principles of animal biology.

The book begins with a short history of the growth of our knowledge of biology. This is followed by a study of cells and cell structure. Chapter III contains a discussion of elementary chemistry which the authors admit is somewhat experimental. Other chapters deal with the following topics: the functions of protoplasm and cells, cell division, general organization of the metazoa, mechanical support and movement materials and energy, internal transport, disposal of wastes, unity and control, reproduction, the breeding habits of animals, embryonic developments, genetics, classification of animals, animals and their environment, geographic distribution, fossil animals, and evolution.

—Elwood D. Heiss.

PENDRAY, G. EDWARD. *Men, Mirrors, and Stars*. New York: Funk and Wagnalls Company, 1935. 339 p. \$3.00.

During the past few years we have witnessed the appearance of a large number of books attempting to popularize the science of astronomy. Yet the telescope, the chief factor in the long unfolding drama of this science, has too frequently been relegated to the background.

In this book the story of the telescope interwoven with the greatest names and foremost discoveries of astronomy, beginning with a telescope that was little more than a toy, and ending with the mighty telescopes of today's great observatories is told. It is a magnificent story and one that is brilliantly and authentically recorded in this book.

Part I of this book tells of the progress made in astronomy before the invention of the telescope, how the first telescopes came to be made, how astronomy's advances go hand in hand with improvements in telescopes and how the camera and the spectroscope became handmaidens of the telescope. Part II describes in a lucid manner how telescopes are made, how they are mounted, and how they work. Part III tells of modern telescopes and the astronomers who use them. There is also an appendix which lists the largest telescopes and where they are located.

—Elwood D. Heiss.

Symposium. *Home Science Experiments*, Parts I and II. State College, Pa.: The Science Leaflet, 1936. 30 p. each.

These two bulletins contain directions for doing many interesting science experiments, answers to contest questions, and interesting science notes. Science experiments from each of the fields of science are included. Elementary and general science teachers will find these two bulletins most useful.

—C.M.P.

HEILBRUNN, L. V. *An Outline of General Physiology*. Philadelphia: W. B. Saunders Company, 1937. 603 p. \$5.00.

Here are forty-two chapters giving an unusually fine collection of new and interesting data concerning the biochemical and biophysical activities of living cells. Significant chapter headings are—The food requirement of organisms, Colloid chemistry of protoplasm, Protoplasmic oxidation, Muscular movement, The production of electricity, Theories of stimulation and anesthesia.

Each chapter is essentially an outline of a great array of recent experimental studies of cellular activities. The whole forms a valuable source for the varied aspects of general physiology and an easy path to the original studies themselves.

By general physiology is meant cellular physiology. It goes without saying that research workers select for their studies of particular activities those cells, wherever they may be, in which their problems can most easily and clearly be investigated, checking their results to make sure they apply to human problems. It seems to me that only in this way can an adequate understanding of physiology be gained for use as a basis of something satisfactory and lasting in the field of hygiene.

Students of general physiology must be equipped with a knowledge of physics, chemistry, anatomy, histology and human physiology to appreciate their findings. However, many landmarks in the shape of familiar facts of anatomy and physiology make it possible for us as teachers of science to glean much material from a book of this sort to illuminate and knit together and open up in new ways our own fields of knowledge. The book makes a fine reference book for teachers of science.

—Caroline Stackpole.

FISHER, CLYDE. *Exploring the Heavens*. New York: Thomas Y. Crowell Company, 1937. 223 p. \$2.50.

Legend, theory, and fact relating to the heavenly bodies are here interwoven into an intensely interesting account. Technical details are omitted, but its attractive style and a wealth of information make strong appeal to both student and general reader. There are many fine full-page illustrations.

—W.G.W.

MENDENHALL, C. E., EVE, A. S., AND KEYS, D. A. *College Physics*. Boston: D. C. Heath and Company, 1935. 592 p. \$3.76.

This book offers an introductory course in col-

lege physics. "An effect has been made to keep the mathematic requirements to a minimum." In spite of this statement it does not seem to give rather strong emphasis to mathematical treatment. However, if the "starred" sections are omitted, the mathematics will be materially reduced. The titles of the chapters covered are: "Dynamics," "Statics," "Hydrostatics," "Fluids," "Matter," "Waves," "Sound," "Heat," "Magnetism," "Electrostatics," "Current Electricity," "Radio," "Light," "Photoelectricity," "Radio Activity," and "Atomic Structure." The book is well illustrated, having 546 illustrations.

—W.G.W.

HOGG, JOHN C., AND BICKEL, CHARLES L. *Elementary Experimental Chemistry*. New York: Oxford University Press, 1937. 288 p. \$2.00.

This manual is independent of any text and offers selected experiments specifically aimed to stimulate "clear, independent, and original thinking." It represents first year work. Part I gives prominence to quantitative work. Part II is mainly of a descriptive type, and Part III offers a wide variety of approach. Diagrams are given, and blank pages are left for student records.

—W.G.W.

WARE, GEORGE WHITAKER. *Southern Vegetable Crops*. New York: American Book Company, 1937. 467 p. \$4.00.

Both vegetable and flower gardening are enjoying renewed and deserved popularity. Relatively, the south bids fair to make greater advances in the next few years than any other part of the country, particularly in vegetable gardens. Perhaps this is because so many southern homes have not had adequate vegetable gardens and now sense the need and possibility of a ready and constant supply of garden products. The book "Southern Vegetable Crops" will be of great assistance in developing such gardens.

Twenty-seven specialists have assisted the author in preparation of this volume. One part of the book deals with "Principles," the other with "Practices," but all is practical and informing from the point of view of one who wishes to understand a garden and make it effective. The unusually high scientific quality of the discussions and directions will make this book widely useful.

—O.W.C.

JOSEPH W. BIGGER. *Handbook of Hygiene*. Baltimore: William Wood and Company, 1937. 405 p. \$4.00.

Intended primarily for medical students, this handbook is also useful to nurses and physicians. It gives practical and reliable information needed by medical practitioners. Its chapters include: "Vital Statistics," "Communicable Diseases," "Diseases Introduced by Mouth," "Respiratory Tract and Inhalation," "Insect Borne Diseases," "Disinfection," "Insects and Vermin," "Parasitic Worms," "Water," "Food," "Air and Ventila-

tion," "Disposal of Waste," "Occupational Hygiene," "Poisonous Gases," "Maternity," "Personal Hygiene" and "Normal Health."

There are a few line cuts and several useful tables.

—W.G.W.

HOLMES, HARRY M. *Laboratory Manual of General Chemistry*. New York: The Macmillan Company, 1937. 299 p. \$1.50.

This is a manual for first year college students. It covers the usual first year experiments and a few newly devised experiments of the same grade. It was written to accompany the author's *General Chemistry* and *Introductory Chemistry*. There are some more difficult experiments offered for the more capable students, or as substitutes for simpler experiments the students may have performed in the high school. The sheets are perforated and detachable and spaces are left for students' notes.

—W.G.W.

WERTHEIM, E. *A Laboratory Guide for Organic Chemistry*. Philadelphia: P. Blakiston's Son and Company, 1937. 518 p. \$2.00.

This very comprehensive manual comprising 145 experiments is designed for a year's course in elementary organic chemistry. This contains much more material than could be done in a year by any individual, thus allowing for selection. The author has reduced the mechanics of efficient laboratory management to a fine art. Many details of laboratory management are incorporated in the instructions to make for safety and efficient use of time. The sheets for reporting experiments are detachable. The usual organic preparations are given, with some not so common experiments. Provision is made for interrelating demonstrations of troublesome points by the instructor. Certain preparations with minimum quantities and identification experiments are utilized to show the importance of identification of compounds through the preparation of derivatives. An estimate of the time required is given for each experiment. The appendix includes first aid instructions, a diagrammatic scheme to show preparations in series; the product of one forming the starting point of another, various tables of constants; a list of experiments which use each chemical or re-agent; a list of re-agents, with quantities, for each experiment; a list of special re-agents, and an index.

—O. E. Underhill.

KUDER, MERLE. *Trends of Professional Opportunities in the Liberal Arts College*. New York: Bureau of Publications, Teachers College, Columbia University, 1937. 236 p. \$2.35.

While this catalogue study has implications for all liberal arts colleges, the actual facts collected apply only to eleven independent liberal arts colleges in the New England states. The conclusions are based upon specific conditions found in every fifth year from 1883-84 to 1933-34.

The data refer to positions in the staffs of these colleges—teaching and non-teaching; college growth; changes in the instructional and non-

instructional fields; trends in specialization; opportunities for women; degrees of college teachers; turnover and length of tenure; and rate of advancement in teaching positions.

In general a healthful growth and gradual adaptation to present-day living is in evidence. Some of the data indicate desirable additions to the faculty increasing the teacher and student ratio; relative increases in the importance of economics, physical education, French, music, English, sociology, Spanish, education, history, and philosophy; increasing importance of non-instructional features especially new types representing guidance and placement, recreation and extracurricular activities, publicity and alumni affairs; and a gradual increase in the relative number of instructors holding advanced degrees.

The appendix includes 102 pages of tables and charts giving detailed and clear pictures of the facts upon which the conclusions are based. These facts indicate that liberal arts colleges are not only holding their own, but making real progress. While population has increased 148 per cent in the United States, student enrollment in colleges has increased 548 per cent and the liberal arts colleges have shared definitely in this advancement.

The avowed purpose of this study was for vocational guidance purposes. It gives evidence, then, of an expanding field in liberal arts education—a conclusion which is possibly opposed to general popular opinion.

—A.W.H.

GILLSON, MARGERY STEWART. *Developing a High School Chemistry Course Adapted to the Differentiated Needs of Boys and Girls*. New York: Bureau of Publications, Teachers College, Columbia University, 1937. 95 p. \$1.60.

This is a doctor's thesis which had as its purpose the ascertaining of what chemical knowledge is functioning in the daily lives of individuals and whether certain chemistry material is more useful to women than to men, and *vice versa*. A list of 340 objectives of chemistry were obtained from an analysis of eleven books written by authorities in the field of chemistry and eight secondary chemistry textbooks. The list of 340 objectives was refined to a list of 100 objectives which were submitted by means of a questionnaire to a representative group of adults numbering 950 who were to mark each objective on a five point scale ranging from "greatest value" to "no value." A second questionnaire containing a slightly different list of objectives was submitted to former students of the investigator.

The following are a few of the conclusions given: (1) Some phases of chemistry are more useful to women than to men and *vice versa*. Women need more instruction about carbon compounds than they are receiving; (2) Much chemistry taught in high school does not function in the later lives of the pupils; (3) Chemistry is of interest to men and women; (4) Chemistry should be included in the training of a larger percentage of the school population; (5) Chief changes in the subject matter of high school chemistry should

occur in the second semester as now organized; (6) The starting point of the course should be practical, not theoretical.

This study has the usual weaknesses of questionnaire studies, almost fatal in this case, and too much dependence should not be placed on any conclusions drawn therefrom. Several conclusions based on the data are self-evident without the study. The reviewer would disagree with the writer that Avogadro's hypothesis should be omitted from the high school course because the "two statements about gases cannot be verified by demonstration or experimentation in high school." If that be the basis for such elimination a great deal of the content of secondary physical science courses would have to be omitted—much even that the writer admits she would include in a chemistry course, *e.g.*, structure of matter—atomic, molecular, electronic; oxidation-reduction principle; ionic theory, and so on. It may be that Avogadro's hypothesis should be omitted, but certainly not on the basis the author indicates.

—C.M.P.

HOLLEY, CHARLES ELMER. *High School Teacher's Methods*. Champaign, Ill.: The Garrard Press, 1937. 514 p. \$3.00.

Science teachers, old and new, will find this book delightful reading. The style has a directness and simplicity that will appeal to many. Some will approve most heartily the impression of authoritarianism; others will be irritated for the same reason. The author very seldom leaves the reader in any doubt as to what he thinks concerning the problems discussed. This has some merits as the neophyte in secondary education methods is all too often unduly confused by the conflicting psychologies and philosophies of modern educational theory.

Some of the chapter headings are: "Problems Involved in Learning to Do the Work of the Teacher"; "The Motivation of Learning Activities"; "Providing for Individual Differences"; "The Development Lesson"; "The Morrison Teaching Cycle for Science Units"; "Reflective Thinking or Problem Solving"; "Directed Study"; "Individualized Instruction"; "Using the Laboratory and the Library"; and "Measuring the Results of Teaching."

—C.M.P.

MELLON, M. G. *Methods of Quantitative Chemical Analysis*. New York: The Macmillan Company, 1937. 456 p. \$3.00.

This seems to be a very practical book in elementary quantitative chemical analysis. The book is intended to teach students how to analyze substances acceptably and to give as much as possible of the fundamental theory underlying the technique of the process employed. The student should find little or no difficulty in following directions and understanding the principles explained. This book constitutes a real advance in technique and readability, in comparison with similar books of a decade or so ago.

—C.M.P.

SHECKELL, THOMAS O. *Trees*. New York: Frederick A. Stokes Company, 1936. \$4.00.

This "pictorial volume for lovers of nature" is

by the photographer of a previous study, "In the Path of the Storm" which won the American Forestry Association's first prize as "the most beautiful photograph of trees in America." It comprises eighty-two studies of trees with a few lines of descriptive captions for each. These studies range from the rugged and struggling cypress of Monterey on the Pacific to the pines of the Maine coast, present trees in all their seasonal moods, and show as much beauty in the common scenes of country road and farm in Jersey or New York as in the uniqueness of the Joshua trees of the Nevada desert or the dunes of Cape Henry. This is a beautiful set of photographs, beautifully bound. The page size is 7½ by 10½ inches.

—O. E. Underhill.

WILSON, SHERMAN R. *Descriptive Chemistry*. New York: Henry Holt and Company, 1936. 312 p. \$1.20. *Descriptive Physics*. New York: Henry Holt and Company, 1936. 231 p. \$1.20.

A large proportion of the pupils enrolled in American secondary schools do not go on to college or university. For them, science courses of the college preparatory type are not the best for their needs. It is primarily for this group that the books under review were written. They are intended for use in one-semester courses with pupils who are primarily interested in knowing what chemistry and physics "are all about" rather than going very deeply into theory or technicalities. The chapter titles in the book on chemistry are "The Composition of Matter"; "The Atmosphere"; "Fire and Fuels"; "Acids, Bases, and Salts"; "Foods, Drugs, Poisons"; "Clothing and Cleaning Agents"; "Building Materials"; and "More Metals and Alloys." In the physics textbook the chapter titles are "The Molecules at Work"; "Sound"; "Light"; "Heat"; "Mechanics"; "Magnetism"; "Static Electricity"; "Electric Cells and Batteries"; "Dynamamos, Motors, and Electrical Transformers"; "Electrical Communication." The latter has an appendix giving important constants, and both books have an index. Each chapter is followed by a large number of review questions. The books are well illustrated with photographs and diagrams.

A careful perusal of these two volumes shows that the selection, organization and presentation of the material is not substantially different qualitatively from that in a good modern textbook in these subjects for high-school pupils. They differ greatly in a quantitative sense, however, from such textbooks. Most of what they contain can be found in a modern high-school textbook but a large part of the theoretical, difficult, and uninteresting material usually found in books of the latter type has been left out of these. With respect to organization it is only necessary to point out that the books make no pretense of being radical or even different in this respect. There is no attempt at use of the unit plan, supplementary readings, or graded instructional materials. No laboratory ex-

periments are given and no laboratory manual to accompany them has presumably been written. In fact, the author states in his prefaces that the laboratory experimentation is expected to consist mainly, if not altogether, of teacher demonstrations. The presentation of the material is straightforward and interesting.

These two books are brief and stimulating introductions to chemistry and physics respectively. Any literate layman could read them with understanding and profit, as could the average 11th or 12th grade pupil. There is a minimum of theory introduced at the start to furnish a basis for understanding. Having covered that, the remainder of each book is devoted to a discussion of how these respective sciences touch present-day living most intimately and importantly. They do not claim to be thorough and exhaustive treatises; they merely introduce the reader to fascinating new fields. They allow much latitude for both teacher and pupil.

Instruction in chemistry and physics is at present in a state of uncertainty. Still to be served is the numerous though relatively small group of high-school pupils who take these subjects for college entrance. The much larger group, numerically and proportionately, who take them for cultural purposes or for vocational reasons are demanding instruction of a different kind than that which is ordered for the college group. One of the trends seems to be toward a fused course in physical science with no distinct lines of demarcation between the separate sciences. Another apparently is the development of separate courses in chemistry and physics for non-college preparatory pupils. It is for such courses that these books are designed. They should fit the purpose admirably. The publishers are to be congratulated for a fine piece of work in printing and format.

—V.H.N.

McKREADY, KELVIN. *A Beginner's Star Book*. New York: G. P. Putnam's Sons, 1937. 154 p. \$3.50.

This is the fourth edition of a book that first appeared in 1912. While it is a book for beginners with most of the astronomical technicalities left out, it does not lack soundness and sobriety of statement. It is one of the finest, if not the best, books for the beginner that the reviewer has chanced upon. Clear explanations, excellent photographs and practical, useable star charts make it a first choice for amateurs. There are star charts for each month of the year. The uninitiated are skillfully introduced step by step to some familiarity with the various constellations so that by using a star chart each of the major constellations can be recognized.

The reviewer unhesitatingly recommends this book to all beginners in star observation. General science and science survey course teachers will find it an interesting reference book and a practical guide.

—C.M.P.

YOUNG, MARGARET VEITCH, AND YOUNG, GERALD O. *Black Gold*. Chicago: Young and Phelps, 1935. 32 p. \$0.50.

This book on the petroleum industry was the first of a series on the industries of the United States. The purpose is "to provide accurate information, technically correct illustrations, combining romance of art and detail of photography." The material has been tried out in a number of schools. The book is artistic and the material can well be used in science classes.

—C.M.P.

McINTOSH, DANIEL COBB, AND ORR, DON MATHIS. *Practical Agriculture for High Schools*. New York: American Book Company, 1937. 518 p. \$1.40.

This seems to be an excellent textbook for agriculture classes in high school. The textual material is approached from "the view-point of the general vocational and cultural function of secondary education." The authors consider the economic viewpoint the best approach to the study of agriculture. In addition to the usual discussion of farm animals, space is devoted to: (1) Factors affecting agriculture; (2) Agricultural resources; (3) Planning the farm program; (4) Agriculture during periods of depression; (5) Marketing farm products; (6) Soil conservation and improvement; (7) Cultural practices and crop rotation.

This book would serve a useful purpose as a supplementary book in biology classes.

—C.M.P.

TREWARTHA, GLENN T. *An Introduction to Weather and Climate*. New York: McGraw-Hill Book Company, 1937. 373 p. \$3.00.

This is one of the McGraw-Hill series in Geography under the editorship of V. C. Finch. The book will supply a long-felt need for there has been no really modern up-to-date textbook in this field. It will serve two college fields: geography and science survey courses. In the latter it should prove quite useful as a first supplementary book on the material relating to weather and climate. The style is very readable and the illustrations pertinent. The reviewer would have appreciated a section devoted to U. S. and World Weather Records and descriptions of some unusual weather conditions and their causes, e.g., the greatest snow storm; the coldest winter; the greatest drought, and so on.

—C.M.P.

WILLIAMS, SAMUEL H. *The Living World*. New York: The Macmillan Company, 1937. 704 p. \$3.60.

In organization this is a somewhat unusual book. Part I, devoted to the "biological aspects of living things," is distinctly a biology textbook—making an integrated, correlated study of animals and plants. Parts II and III are distinctly zoological and botanical, respectively. As

407 pages are devoted to the former and 97 pages to the latter, one could easily guess that this unfavorable balance is due to the fact that the author is a zoologist. Animals are studied by classifications. This scheme has some advantages, but probably more disadvantages. The writer does employ a quite readable and interesting style. The book will serve as a most useful reference book.

—C.M.P.

WHITBECK, RAY HUGHES, DURAND, LOYAL, AND WHITAKER, JOE RUSSELL. *The Working World*. New York: American Book Company, 1937. 704 p. \$2.20.

This is an economic geography intended for use in high-school classes. The organization is regional, although combining the two approaches, the one by regions, the other by occupations and commodities. The authors are members of the department of geography of the University of Wisconsin.

There are 341 illustrations and photographs which together with an abundance of maps add much to the attractiveness and usefulness of the content material. As a textbook, it should prove to be most adequate; as a source of supplementary reading and statistical data, the book will be of value to the science library.

—C.M.P.

DAHL, IROQUOIS. *1001 Outdoor Questions*. New York: Funk and Wagnalls Company, 1937. 406 p. \$2.00.

For almost ten years the author has run a page each month in *Field and Stream* entitled "1001 Outdoor Questions." This book lists, alphabetically, many of the questions that readers have asked Mr. Dahl, and the answers he has given to those questions. The questions and answers comprise an interesting compendium of biological nature knowledge. It is a book that biology students will thoroughly enjoy reading—a book that one can use as a basis of "Ask Me Another."

—C.M.P.

KINSEY, ALFRED C. *Methods in Biology*. Chicago: J. B. Lippincott Company, 1937. 279 p. \$2.50.

This is a most interesting, readable book. It represents a viewpoint that permeates the philosophy of many teachers of pure science. "Science teachers are mostly born science teachers—few can ever be trained." Methods courses are an abomination, peradventure they may have to be put up with because of questionable state certificate requirements in education.

The author is often dogmatic in his enunciations. With many of his dictums, the reviewer is in accord; with as many other he is in complete disagreement. This book does offer contrast with other recent methods books in science and the often excellent summarizations of contrasting viewpoints may be most useful.

—C.M.P.

Editorial Staff of Popular Science Monthly. *Fix It Yourself*. New York: Grosset and Dunlap, 1935. 356 p. \$1.00.

The fact that this book has gone through eight printings attests to its popularity. The book was written originally in response to a demand for a book that would tell how to do simple repair jobs. For many years the Home Workshop Department of *Popular Science Monthly* has been telling how to do repair jobs. A part of this work appears in this book. Many boys interested in science and "fixing things" will find this book their delight.

—C.M.P.

Editorial Staff of Popular Science Monthly. *Auto Kinks*. New York: Grosset and Dunlap, 1935. 192 p. \$1.00.

This is another of the "Do It Yourself" series of books. It is a handy manual of short cuts and ingenious ways of keeping a motor car in condition and doing emergency repair jobs. Many *Popular Science Monthly* readers have followed the adventures of Gus in repairing auto kinks. He's about the best "auto kinks" eliminator extant. Of course if you never have had any car trouble and never expect to, you would not be interested in this book.

—C.M.P.

Editorial Staff of Popular Science Monthly. *Astronomy for Amateurs*. New York: Grosset and Dunlap, 1935. 192 p. \$1.00.

This is another "Do It Yourself" book, intended more as a tool than as a textbook. The purpose of the book is to make plain all the chief principles of astronomy and their practical applications by means of simple experiments, using everyday objects. General science and elementary science teachers, as well as general science students will find this a most useful book.

—C.M.P.

Editorial Staff of Popular Science Monthly. *A Book of Formulas, Recipes, Methods and Secret Processes*. New York: Grosset and Dunlap, 1936. 250 p. \$1.00.

This is an excellent book for the high-school chemistry class, the general science class, or the science club.

Here you will find hundreds of formulas for making pastes, glues, dyes, paints, beverages, cosmetics, family medicines, perfumes, lacquers, toothpastes, insecticides, polishes, and so on. Each formula has been chosen from the most authoritative source possible and many were devised, tested and recommended by the United States government scientists of high standing.

—C.M.P.

STOKLEY, JAMES. *Stars and Telescopes*. New York: Harper, 1936. 319 p. \$3.00.

This is a book for amateur astronomers. It is by the Associate Director of the Franklin Institute in charge of the Fels Planetarium in Philadelphia.

It begins with the heavens as the layman sees them at night. Star maps for the varying seasons are presented. There follows a treatment of the motions of heavenly bodies. Next comes a brief history of the development of the ideas of astronomy.

The second phase of the book is concerned with the history, construction and use of telescopes. There follows a treatment on the building and use of amateur telescopes.

The latter chapters deal with time, the moon, the sun, the planets, comets and meteors, various types of stars, nebulae, the galaxy, spiral nebulae, and with life in the universe.

The book is well illustrated both with diagrams and photographs.

This volume is recommended for general reading, as a guide for the amateur astronomer, to the high-school teacher, and for inclusion in the science collection of the high-school library.

—R.K.W.

MAYER, JOSEPH. *The Seven Seals of Science*. New York: D. Appleton-Century Company, 1937. 430 p. \$3.00.

This is a revised, and a student's, edition of an excellent book first published about ten years ago. Changes in the text have been made to bring it up to date. Descriptive subheadings have been added, a good index introduced, supplementary reading cited for each chapter, and an excellent bibliography appended.

This survey of the sciences aims to show how the sciences have developed, forming a well-defined structure with mathematics at the foundation, each later science being built upon those that went before, with psychology only now becoming a science, and with social studies having the opportunity to become a science in the future by building upon and using the methods of the sciences of the past.

The changes, together with the decrease in price, have resulted in producing not only a very readable book for the educated layman, but also a very valuable aid to students in the field of cultural science.

—O. E. Underhill.

Picture Scripts, edited by a group of teachers within Lincoln School of Teachers College, Columbia University. New York: Grosset and Dunlap, Inc., 1936. \$0.15 each.

Tippett, James S.: *The Picnic*

This is a story of a rural negro family and their picnic at the creek. It is simply written, and illustrated with drawings in black and white. The story is full of activity and teems with interest from beginning to end. It is a book which the pre-school child will beg to have read to him again and again, and one which the child in primary school will love to read for himself.

Ackley, Edith Flack: *How to Make Marionettes*. 24 p.

This book of simple directions is sponsored by the National Recreation Association to the end that children and adults in schools, homes, churches, clubs and playgrounds may learn how to make marionettes. The book is richly illustrated with photographs and drawings.

Watson, Elizabeth: *Matilda the Old-Fashioned Hen*

This is an amusing story in rhyme of a setting hen, a proud rooster and their twelve downy chicks illustrated by drawings in black and white. Although not strictly scientific it would be interesting to read to kindergarten and first grade children.

Keelor, Katharine: *Along the Busy River*. 46 p.

A story of the river in rhyme for the lower grades,

accompanied by full-page drawings in black and white. The life of the river is traced from its narrow source to the broad mouth at the sea and one gets the sense of ceaseless activity from the reading. The seasons and the relation of man to the river during the different seasons are written about.

Anonymous: *Airplanes*. 24 p.

This is a companion book to *Trains and Boats* and is one of a series of single stories based on children's interests for use in the school and in the home. It tells the facts about airplanes in modern transportation which every child wants to know. The book is illustrated with photographs from the American Airlines, Inc. It can be used from the first grade on.

—L.M.S.

PILLSBURY, ARTHUR C. *Picturing Miracles of Plant and Animal Life*. Philadelphia: J. B. Lippincott Company, 1937. 236 p. \$3.00.

The author has spent most of his life adapting photography, particularly lapse-time photography, to plant and animal life. This book, describing his activities, is fascinating not only because of the interesting information and splendid illustrations dealing with the plants and animals, but also because of the interesting presentation of his methods of work and of the problems he had to solve.

—O. E. Underhill.

COLLINS, A. FREDERICK. *The March of Chemistry*. Philadelphia: J. B. Lippincott Company, 1936. 275 p. \$3.00.

This presents an excellent picture of the results of applied chemistry. The newer (although not so new as the emphasis given by the chapter titles might indicate) materials, apparatus and processes are described and much interesting detail given which is not usually found in the popular treatment of applied chemistry. Sufficient fundamental theory is interwoven to give the necessary background for understanding what is being written about, but it does not intrude itself. The scope is best described through the chapter titles: "The New Saga of Chemistry," "The New Inorganic Discoveries," "New Methods and Apparatus," "New Organic Compounds," "New Radio-active Substances," "Some New Heat Producers," "Some New Cold Producers," "The New Chemistry of Photography," "New Electrochemical Processes," "Some New Synthetic Products," "About the New Metals," "New Explosives and War Gases," "New Biochemical Discoveries," "The New World of Agriculture." The numerous photographic illustrations are excellent. Some of the line cuts, which average nearly one to a page, contribute little, and others could be somewhat improved, but on the whole they too add much to the attractiveness and utility of the book.

—O. E. Underhill.

ILIN, M. *Turning Night into Day. The Story of Lighting*. Philadelphia: J. B. Lippincott Company, 1936. 119 p. \$1.00.

A translation from the Russian tracing the story of lighting from the primitive bonfire in the center of a room, to the electric light bulb, neon tubes, sodium lamps and other most recent discoveries. The style is simple and interesting, quaintly phrased, but explicit. The original Russian illus-

trations enhance the interest of the book. It is an ideal reference for general science classes.

—L.M.S.

DITMARS, RAYMOND L. *The Book of Living Reptiles*. Philadelphia: J. B. Lippincott Company, 1936. 64 p. \$2.00.

This is a very readable book on the reptiles of the world to-day. Each of the nine chapters treats of the reptiles in a definite geographical area, e.g., Chapter I, the United States and Canada; Chapter II, the Galapagos Islands.

Beautifully illustrated maps of each region with the reptilian inhabitants in color are given. A bibliography on reptiles is appended. From the child in fourth or fifth grade to the advanced student, this book is of value.

—L.M.S.

FROST, EDWIN BRANT. *Let's Look at the Stars*. Boston: Houghton-Mifflin Company, 1935. 118 p. \$2.00.

This is a good book on the heavenly bodies for boys and girls of twelve to fifteen years. The material is discussed in a clear, interesting fashion, yet the whole range of astronomy is covered. The book is up-to-date and is well illustrated with photographs made at the Yerkes Observatory. It should be on reference for every general science course.

—L.M.S.

VINAL, W. G. *Tree Calendar, Key and Check-list*, also *Bird Calendar, Key and Check-list*. Geneva, New York: The Humphry Press, Incorporated, 1937. 2 copies for 5c; \$2.00 per hundred.

In both of these check-lists there are blank spaces for recording data and place of trips and for identification of birds, and trees. Characteristics of birds and both summer and winter characteristics of trees are given as an aid to identification.

—W.G.W.

DENISON, MERRILL. *Advancing America*. New York: Dodd, Mead and Company, Inc., 1936. 303 p. \$2.00.

This book presents a panorama of America's growth in transportation and communication by a text which intersperses brief dramatic interludes with the straight narration. The inspiration for this plan is attributed to the radio with its programs of interpretation of various phases of American life. For instance a supposed conversation between Peter Cooper, Stokes, and the crowd is given as Peter Cooper in his "pint-sized train" the *Tom Thumb* races a loaded horse car. The book is filled with the excitement which conversation can supply.

The book suffers from a lack of illustrations but it contains a vast amount of valuable information presented from the viewpoint of human interest.

—L.M.S.

GRAY, GEORGE W. *New World Picture*. Boston: Little, Brown and Company, 1936. 403 p. \$3.50.

Science has made and is still making a New World Picture. In giving us our present picture of the universe, the most significant findings have been made at the two poles of knowledge, one the infinitely small realm of the atom and the other the infinitely great universe of the galaxies. The author in his preface says "Science is man's attempt to understand the Universe. This book is an attempt to understand science. It is written out of the experience of personal contacts, visits to laboratories and observatories, interviews and correspondence with specialists in the field of physics and chemistry. Its purpose is to give an account of the scientific world view of today."

In this new world picture—biological sciences are not included, nor is there much material from the fields of geology or chemistry, except in so far as the latter merges with physics in discussions on the atom. To this extent the title of the book is misleading. In the fields discussed, however, one finds one of the best accounts now available in popular science. It is somewhat of a history of the development of physical science.

Mr. Gray promises to be one of our outstanding interpreters of science to a civilization whose destiny rests so directly on the future of this new-gained knowledge. He writes understandingly, accurately, entertainingly. This is a book unreservedly recommended as excellent supplementary reading material for survey courses in science and to secondary and elementary science teachers.

—C.M.P.

EDWARDS, PAUL G., AND SHERMAN, JAMES W. *Earth and Sky*. Boston: Little, Brown and Company, 1937. 278 p. \$0.92.

This is book IV in the series of nature activity readers. It comprises selections on nature topics by various authors, many of them well known. The arrangement is seasonal. The subject matter relates to birds, trees, insects, plants, and natural phenomena. There are sixty illustrations which make the book very attractive. The important features are the "problems and questions" and particularly the "something to do" suggestions which occur rather frequently throughout the book.

—W.G.W.

GRAHAM, VERNE O., AND SHERMAN, JAMES W. *Forest Families*. Boston: Little, Brown and Company, 1937. 315 p. \$0.96.

This is book V of the series of nature activity readers. These readers through the suggested activities strive to create desirable attitudes and habits of inquiry into the field of nature study and elementary science. Seasonal treatment is followed. The stories about trees, birds, animals, insects, plants, and natural phenomena are selected chiefly from able authors. Besides the "something to do" suggestions there are valuable exercises on "something to think about." The book is well illustrated with half-tones and drawings by Beatrice Stevens.

—W.G.W.

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